ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. LIII. No. 4. NEW YORK, SATURDAY, JULY 25, 1908. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . VICE-PRESIDENT
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK
PUBLISHING OFFICE . . . . . 13-21 PARK ROW
CHICAGO
WESTERN OFFICE . . . . . FISHER BUILDING
BOSTON
NEW ENGLAND OFFICE . . . . . 95 MILK STREET
LONDON
EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE

TELEPHONE "21 Cortland." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States	$3.00
One Year, Canada	4.00
One Year, Foreign Countries	6.00
Single Copy, 10 cents. Back numbers, beyond one month, each	.25

ADVERTISING

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Published weekly by the ELECTRICAL REVIEW PUBLISHING COMPANY, 13 Park Row, New York. Charles W. Price, president and treasurer; Stephen H. Goddard, vice-president; H. S. Tuthill, secretary.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS

EDITORIAL:
The Oscillograph in the Shop 117
A Noteworthy Hydroelectric System 118
Slaves of the Clock 119
Refuse Destructors and Power Plants 119
The Manufacturer and the Engineer—and Engineering 119
Should Manufacturers Cease Doing Free Engineering? 120
Financial Reports of Electrical Companies 120
National Electrical Contractors' Association 121
American Telegraph and Telephone Company 122
New York, New Haven & Hartford Railroad Company to Build New Lines 122
Some Engineering Features of the Southern Power Company's System, by J. W. Fraser 123
Extensive Trolley-Terminal Plans 125
Annual Convention of the American Institute of Electrical Engineers (Concluded) 126
Electrical Contractors' Opportunities in the Illuminating Field, by George Loring 131
Condemns New York City Fire-Alarm System 134
Experiments on a Directive System of Wireless Telegraphy 134
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE 136
London Tube Finances 137
INDUSTRIAL SECTION:
The International Electric Meter Company's Measuring Instruments 138
Darrin Magnet Switches 139
Moisture-Proof Pole Cable Terminals and Junction Boxes 139
The Stave Flaming Arc Lamp 140
Wheeler Reflector Company's New Fixtures 140
"Verus" Conduit 140
Cutler-Hammer Push-Button Specialties 141
A New Automobile Instrument 142
A Powerful Gasolene Blow Torch 142
New Ajax Specialties 142
The "Success" Chemical Fire Extinguisher 142
Westinghouse Mercury Rectifier Arc-Lighting System 143
The Dielectric Company of America 143
New Receiver for New York City Railway 144
International College Comity—A Unique Ceremony 144
CURRENT ELECTRICAL NEWS 145
RECORD OF ELECTRICAL PATENTS 149

Copyright, 1908, by Electrical Review Publishing Co.

THE OSCILLOGRAPH IN THE SHOP.

The oscillograph is certainly one of the prettiest of research instruments devised by physical science in recent years. Thanks to the ingenuity of Duddell and others we have here an instrument capable of following rapidly changing physical effects; and by the means of auxiliary devices we may either make permanent records of transient phenomena or actually watch these changes as they take place. Until the development of the oscillograph the student of electrical science was considerably handicapped, as all his instruments gave merely averaged values, and when these are used for measuring rapidly changing quantities, such as exist in a circuit through which an alternating current is flowing, the values thus found seem to indicate a departure from the laws known to apply to circuits in which the current is steady. For these reasons it has become more or less customary to study the flow of alternating currents from the mathematical rather than the physical standpoint; the fact that Ohm's law is always the fundamental law of electric flow, no matter what the type of current, is often overlooked.

When attempts are made to study the character of change going on in the alternating-current circuit, before the oscillograph was available, tedious step-by-step methods were necessary, and these were applied at times under a disadvantage, since the points of the curves thus obtained were not instantaneous values, but averages of many such values. But the oscillograph enables us to trace not only the true instantaneous changes, but also to record, when desired, the average series of changes which are going on. The instrument thus became one of considerable scientific importance, and we must credit it with many valuable researches. Nevertheless, it is usually looked upon as a purely scientific instrument, whose place is in the laboratory, not in the shop. For this reason, a short paper contributed to the July issue of the *Electric Journal* by H. H. Gallehar is interesting, as he takes the stand that a suitably designed and equipped oscillograph is an essential piece of apparatus for every testing floor. Such an instrument is not difficult to use and may be easily set up and is not easily influenced by external forces. When such a device is available many troublesome questions which arise during the testing of any electrical device may at once be answered. It will not only show the true character of the current and electromotive-force waves, but it will also show the true difference in phase between them. It gives the testing-floor staff the ability to watch the effects of any changes in conditions upon the apparatus being tested and to determine when the desired conditions for testing have been obtained. It

thus forms a valuable addition to the usual equipment of the testing floor.

It is always interesting to notice the adoption of what is considered a purely scientific instrument to the utilitarian purpose of the testing floor, but it is even more interesting to notice how scientific the methods of the testing floor have become. Indeed, so far as the study of electrical apparatus is concerned, it would be pretty difficult to draw a line separating the so-called practical from the really scientific work.

A NOTEWORTHY HYDROELECTRIC SYSTEM.

One of the interesting and instructing papers presented at the recent meeting of the American Institute of Electrical Engineers at Atlantic City was that by Mr. J. W. Fraser which describes some of the important phases of the hydroelectric developments in North and South Carolina.

On the Pacific Coast and in other sections of the Far West fuel is expensive, and cheap power, or rather cheaper power than can be produced in a steam-driven station, is the desired end and the engineers of the transmission systems which have been built up out there have had this end constantly in view. To supply this demand for power it has been found profitable to transmit it electrically over distances far greater than those covered by transmission systems elsewhere in the world. On the other hand, at Niagara Falls and one or two other places a different condition exists. Here the reason for development was not the high cost of fuel but the opportunity offered by the enormous power represented by the falls and the possibility of producing mechanical power in large quantities at a less cost than could be done by the use of comparatively inexpensive fuel. There was, at the time the work was undertaken, no immediate market for this power; the nearest large market was Buffalo and it was anticipated that the output of the power plants at the falls, after it had been decided to develop them electrically, would be transmitted and sold at distant points. The outcome, however, was somewhat different, for while a good deal of energy was disposed of in Buffalo and other nearby towns, a greater part of it was sold to new industries established at the falls to take advantage of the low rates made them.

In the Carolinas, however, a condition different from either of the above faced those who undertook to develop the water powers of these states. Here there is a large market for power, not concentrated in one point, but scattered over a not very large territory. There are many cotton mills thickly dotted throughout the central part of the two Carolinas which offer the main outlet for the sale of energy. At these mills power was already supplied by steam-driven plants of fairly good efficiency and reliability. Fuel is not particularly costly, and as many of the plants are comparatively new they were not handicapped with old and inefficient machinery. The electrical system must, therefore, compete with good steam-power plants and it must not only be able to sell energy to the mills at a less cost, all things considered, than the mills can make it for themselves, but it must insure as great reliability as a simple steam engine belted to a series of line shafts.

For these reasons reliability became the controlling factor in design, since no mill could afford to depend upon unreliable power, however low the price; yet it was necessary to secure this reliability without an excessive cost of construction. To this end the engineers of the Southern Power Company, whose system is the one described by Mr. Fraser, studied carefully the insulation problem and adopted a factor of safety higher than that usually deemed satisfactory. The apparatus was selected with special reference to reliability and the protective system was thoroughly planned. On one of the more recent lines the factor of safety has been again raised, but this is with the expectation of doubling the transmission voltage on this line some time later. The practical reasons which lead to the selection of 44,000 volts for the present system of transmission lines and for the adoption of the frequency of sixty cycles are given in Mr. Fraser's paper, which is published elsewhere in this issue. Had the present company initiated the work the selection might have been different; but it had to consider one hydroelectric station already existing and the many motors which were in operation in certain of the mills.

There is another interesting phase of the power development of the Southern Power Company's system which was brought out in a few remarks made by Mr. Lee in discussing Mr. Fraser's paper. As on most of the southern rivers the problem of handling floods is serious and the variation in the flow of the rivers is great, the main power station is primarily planned for only the minimum flow. The question then rises if it will be profitable to install more apparatus in the power station and a reserve steam plant which will run during, say, two months of the year. This is one of the points discussed by Mr. Fraser and his conclusions are interesting; but Mr. Lee brought out another phase of the question which we do not remember to have heard discussed before. It will be remembered that a large number of these southern mills have adopted the electric drive because of the increased and improved output of the mills thereby secured, and although a power company might not be able to offer them terms sufficiently low to induce them to abandon their own power station, it might sell them energy at very low rates for about six months of the year and let them run their own power plants during the months when the water is low. To make such an arrangement profitable would require a much larger hydroelectric development than the usual considerations would warrant, but the plan may lead to a solution of the secondary power development entirely different from that arrived at by Mr. Fraser.

To indicate the importance of this southern power system, it may be said that it owns eleven power sites aggregating 150,000 horse-power, and as Mr. Fraser's paper deals mainly with the transmission-line problems some may be interested in learning in more detail the character of the hydroelectric stations which the Southern Power Company is installing. An excellent description of these was given by Mr. Fraser in the ELECTRICAL REVIEW, September 8, 1906.

SLAVES OF THE CLOCK.

Until recently we have looked upon the clock as an interesting physical device adapted by man to divide the day and night into convenient arbitrary periods; but it seems that in London, at least, the clock has risen from this menial position to one more dignified and important. Over there, it appears, the clock regulates man's actions, rather than man the clock's. It fixes the time for his getting up and going to bed; when the office is to be opened and when closed and the time of day when he shall rest his weary body. His brain, we surmise, needs no rest, either because it is never greatly exercised, or else, perhaps, because it has been worn beyond repair. At least, these are the impressions given one when reading the discussions of the proposed plan to shift the working period of the day an hour ahead during the summer and back again to its normal position during the winter, merely by moving the hands of the clock. As a simple suggestion and with the idea of saving a part of the expense of lighting streets and homes by inducing men to start their work earlier in the day, stopping, of course, just that much sooner in the evening, the idea might call forth a few interesting psychological remarks, but when a bill is introduced into Parliament for carrying out this plan, one begins to wonder by what mental process the originator of this plan and those who favor it arrived at the conclusion that the mere shifting of the hands of a clock at the dead of night will bring about a complete rearrangement of the working hours in the British Isles.

The measure is known as the "Daylight Saving Bill," a name which fits it about as well as it itself will fit in with human habits. Those in favor of the scheme seem to be under the impression that since the banks and telegraph offices of London do not open until the summer sun has been trying to shine through the London fog for five or six hours, no one else goes to work any sooner than that, and because custom has fixed the hour for opening certain offices at nine or ten o'clock, or even later, as the case may be, the only way they see of changing this custom is to change the clock. It seems to be a childish way to bring about a reform. Every one is to start to work during the summer an hour earlier than he is accustomed to, but his clock is to show the same old time; therefore, he will not be able to resent the change. But why, if the plan should work successfully during the summer months and show an unquestioned saving of daylight—why should the country return to the old plan during the winter, as it is not apparent that either method would be more economical of light than the other during the short winter day in England?

These questions, however interesting, are psychological rather than electrical and hence we should perhaps be more concerned about the effect the proposed plan would have upon the electric light companies of the British Isles; should not any such attempt to curtail their sales of energy be resented? Yet we have not been so careful in our use of light heretofore, and too frequently we are satisfied if we pay the lighting bills, caring little how the light itself is used. Hence this sudden conversion and a consequent effort to abandon old and wicked ways should be received with caution. Yet we doubt very much, even supposing every one minded the clock, if there would be such a great saving of artificial light as is promised. Would not those who now enjoy the night as a time for pleasure rejoice so much the more at having an hour more for enjoyment that they would unwittingly draw out the time to an hour and a half, or maybe two, with considerable benefit to the lighting companies and with perhaps some detriment to their own welfare? With the latter consideration we have no concern, and since it does not seem likely the lighting companies will suffer seriously from the plan, we are not much alarmed at the prospect presented. We therefore await the issue of this campaign without undue anxiety, leaving it to the Englishman to fight the matter out with his clock, for as Humpty Dumpty said, "The question is, Who is to be master?"

REFUSE DESTRUCTORS AND POWER PLANTS.

During the presidential address of Mr. Herbert Talbot before the Incorporated Municipal Electrical Association of Great Britain at the meeting held in June, the speaker referred briefly to the performance of the refuse destructor plant at Nottingham, England, and from the experience gained there drew an interesting conclusion. The conclusion is about as follows: Town refuse is a more expensive fuel than coal under the conditions existing at Nottingham; hence, it would be cheaper for the electrical system not to utilize the steam produced in this destructor and to produce all of its steam in its boiler plant. To do so would not involve any increase in the staff of the station and indeed would rather improve, as a whole, the operation of this plant, since the load-factor of its boilers is lowered by the operation of the destructor plant. Taking a broader view, however, it is admitted that burning is the best method of disposing of city refuse, and the heat thus produced might as well be utilized. It is then merely a question whether the destructor plant is to be operated for destroying purposes alone and the cost of so doing frankly paid, or whether it is to be operated in connection with the electrical supply system and the latter is to be saddled with the cost of destroying the refuse. The latter arrangement probably results in a small saving to the town, but it rather complicates the work of the electrical department.

THE MANUFACTURER AND THE ENGINEER—AND ENGINEERING.

A somewhat unusual communication on the subject "Should Manufacturers Cease Doing Free Engineering" appears in this issue. For its originality, if for no other reason, it is entitled to consideration. The suggestion therein embodied is certainly radical and, whatever the merits of the case presented, it could only be introduced by a series of transition stages. It would be difficult to conceive of a sudden reversal of the custom which has heretofore obtained, even though the resulting benefits should be all that our correspondent would expect. The subject is important and timely. No doubt there will be forthcoming expressions of opinion from the various sources interested.

Should Manufacturers Cease Doing Free Engineering?

To the Editor of the Electrical Review:

The series of communications on the subject "Is the Consulting Engineer Necessary?" which have appeared in recent numbers of the London *Electrician* and your own British namesake, the *Electrical Review*, and the editorial comments thereon, have probably come before you and your readers.

The consideration of these writings has induced an idea which I herewith lay before you in the hope that it will either be approved and confirmed and lead eventually to a change in the present order of things, or its fallacy pointed out.

My suggestion is, that no manufacturer should bid on apparatus except under specifications from the prospective purchaser or his engineer, and that the manufacturing companies cease making plans and specifications. This suggestion is made in the interests of both the manufacturer and the consulting engineer, but the benefits would accrue principally to the manufacturer. The reasons which appear to make this course advisable are:

(1) The manufacturers would eliminate the cost of an enormous amount of futile engineering, done for people who have not the means to carry out their schemes nor the power to interest capital in them.

(2) The sales departments would have their work, records and expenses greatly reduced because of the elimination of projects which can never be [illegible] to fruition.

(3) Manufacturers of high-grade apparatus would have a better opportunity of getting business on a basis of merit and worth.

(4) Business would be done between the manufacturer and an engineer, and therefore more understandingly, and on a better basis and at a lower cost.

(5) The practice of having one manufacturer prepare plans and specifications at his own expense, to be hawked about to other manufacturers, would be done away with.

(6) Where a prospective buyer applies to several manufacturers for plans and specifications it means that an equal number of specifications—no two of which coincide—are made for a single installation. This obvious and expensive waste of work would be avoided.

The manufacturers could confine their attention to turning out apparatus at the lowest cost consistent with the production of high-grade machinery, reducing their general and sales expenses, because in nearly every instance requests for quotations would come from responsible parties who would be actual purchasers, for no penniless promoter would retain a consulting engineer.

The adoption of this proposed system would require either an agreement among all the manufacturing companies or the independent action of the head of some company who is sufficiently big, broad, strong and wise to take this action, knowing that by his reduction in cost and the friendly attitude of the engineering profession toward any policy which would thus advance its interests, his company would possess no small advantage and would reap the reward of sanity and good judgment.

ENGINEER.

New York, July 11, 1908.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

KANSAS CITY HOME AND LONG DISTANCE TELEPHONE COMPANIES.

The report of the Kansas City Home and Long Distance Telephone Companies for the year ended March 31, 1908, shows gross earnings of $955,212, an increase of $162,338; net earnings of $462,901, an increase of $85,738, and surplus after charges of $258,917, an increase of $68,033.

The Toledo Home Telephone Company, of Toledo, Ohio, reports gross earnings for the year ended December 31, 1907, of $354,618, an increase of $39,330, and surplus after charges of $129,091, an increase of $15,033.

The Kinloch Long Distance Telephone Company, of Missouri, shows gross earnings for the year ended December 31, 1907, of $1,139,151, an increase of $148,911, and surplus after charges of $282,425, an increase of $89,858.

LAKE SHORE ELECTRIC COMPANY.

The Lake Shore Electric Company reports gross earnings for May of $69,538, a decrease of $4,344; net earnings of $29,498, a decrease of $1,421, and surplus of $3,686, a decrease of $3,919. For five months the gross earnings were $307,439, a decrease of $10,521, and net $118,251, a decrease of $4,941. After allowing for interest charges there was a deficit of $10,174, an increase of $15,227.

CHICAGO RAILWAYS COMPANY.

Since the beginning of the present fiscal year, on February 1, the Chicago Railways Company has shown increases in both gross and net earnings. The April, March and February reports, which complete the first quarter of the fiscal year, are given in detail as follows:

Earnings.	April, 1908.	March, 1908.	February, 1908.
Passenger	$847,220	$840,743	$742,826
Sales of power.	1,440	1,552	.....
Other income...	16,775	15,437	16,116
Gross	$865,435	$857,732	$758,942
Expenses:			
Maintenance of structure ...	$54,262	$47,262	$30,087
Maintenance of equipment ..	80,688	69,943	61,245
Operating cars and power plants	356,190	371,276	364,525
General	113,585	99,595	88,362
Real estate income	5,000	3,624	4,008
Taxes	16,608	16,609	16,609
Totals	$626,333	$608,309	$564,836
Balance (actual)	239,102	249,423	194,105
Balance, 30 per cent of gross.	259,630	257,320	227,683
Interest, 5 per cent on value of property..	136,492	136,065	135,788
Net income....	$123,138	$121,255	$91,895
Division:			
City's 55 per cent	$67,726	$66,690	$50,542
Chicago Railway's 45 per cent	55,412	54,565	41,352

As shown by the above figures, the actual operating expenses in April were seventy-two per cent of gross, in March the percentage was seventy-two, and in February they were seventy per cent. This is due to the work of rehabilitation, but after the first part of the work is completed the ratio should decrease rather than increase.

The terms of the ordinance provide that seventy per cent shall be charged to income account for operation. At the end of the year any excess of that figure will be paid into the earnings account out of the capital account, unless the cost of operating should fall below that figure during succeeding months of the year.

The Chicago Railways Company's balance sheet, as of April 30, 1908, compares with that of March 31, 1908, as follows:

	April 30.	March 31.
ASSETS.		
Road and equipment	$33,030,238	$32,758,146
Cash	323,866	1,357,241
Total	$33,354,104	$34,115,387
LIABILITIES.		
Capital	$32,589,047	$32,589,047
Reserve for damages	580,098	545,758
Due city of Chicago.	184,959	980,582
Total	$33,354,104	$34,115,387

The total passengers carried by the Chicago Railways Company lines, cash fare, free and on transfer, increased 1,603,376 in April and 1,092,794 in March. The earnings per car-mile and per passenger are also given in detail for the two months named.

Passengers carried:

	April, 1908.	March, 1908.
Revenue passengers.	17,132,869	16,935,066
Free passengers....	215,777	184,724
Transfer passengers	11,667,959	11,866,843
Total	29,016,959	28,486,633

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION.

EIGHTH ANNUAL MEETING, HELD IN CHICAGO, ILL., JULY 15, 16 AND 17.

The eighth annual meeting of the National Electrical Contractors' Association was held at the Auditorium Hotel, Chicago, Ill., July 15, 16 and 17. The convention was opened with a session of members and guests on Wednesday morning, July 15. A number of contractors from several states were in attendance and there was present also a large representation of manufacturers.

The address of welcome was made by Henry Newgard, president of the Illinois Electrical Contractors' Association. The first paper, entitled "The Electrical Contractor's Opportunities in the Illuminating Field," was read by the author, George Loring. An abstract of this paper is presented elsewhere in this issue.

A paper entitled "The Relations Between the Underwriter and the Contractor" was read by W. H. Merrill, Jr., manager of the Underwriters' Laboratories, Chicago, Ill.

These papers were discussed briefly, both Mr. Loring and Mr. Merrill replying to numerous questions. Mr. Merrill invited those attending the convention to visit the laboratories, which are conducted under the direction of the National Board of Fire Underwriters.

The contractors were the guests of the Chicago Electric Club at luncheon, and in the afternoon a business session was held at two o'clock.

On Wednesday evening banquets for both the ladies and gentlemen were held in the Auditorium Annex, the banquet rooms being thrown together after the repast and a fine vaudeville programme thoroughly enjoyed.

On Thursday morning there was an open session for members and guests. J. R. Cravath presented a very interesting discourse on "Illuminating Engineering." In the course of his remarks Mr. Cravath said: "The contractor who has a sufficient knowledge of illuminating engineering so that he can go to the dissatisfied user of an unsatisfactory lighting installation and guarantee him more results for the money he is expending for light can create business and get work which otherwise would not be available." He called attention to some of the first principles of interior illumination and indicated the proper method of attacking such problems of artificial illumination as would ordinarily come within the province of the electrical contractor.

Alex Dow addressed the session on the topic, "The Relations Between the Lighting Company and the Contractor," followed by Seth B. Wetherbee, on the topic, "The National Electrical Contractors' Association."

On Thursday afternoon a brief business session was held, and the members were later taken in tally-hoes to the National League Park, where an exciting baseball game between the New York and Chicago teams was witnessed. The party returned to the Auditorium in tally-hoes. During the afternoon the ladies enjoyed an automobile trip through the south parks and boulevards.

At 7.30 o'clock Thursday evening the members met in business session, the ladies attending the performance of "The Top o' the World" at the Studebaker Theatre. At nine o'clock a Rejuvenation of the Sons of Jove was held at which fifty new members were initiated into the mysteries of the order.

On Friday all the members and guests enjoyed an all-day outing to Michigan City, going by way of the steamship Theodore Roosevelt. A repast was served on both trips and while at Michigan City there were races for the ladies, a fat men's race, potato race, swimming race and a baseball game between the eastern and western contingents, the former winning by a score of ten to seven.

The following officers were elected for the ensuing year:

President, G. M. Sanborn, Indianapolis, Ind.

First vice-president, M. L. Barnes, Troy, N. Y.

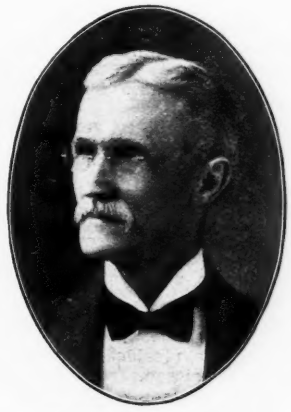
Second vice-president, Charles R. Krieder, Chicago, Ill.

Third vice-president, H. S. Potter, Boston, Mass.

Treasurer, John R. Galloway, Washington, D. C.

Secretary, W. H. Morton, Utica, N. Y.

G. M. SANBORN,
President National Electrical Contractors' Association.



JOHN R. GALLOWAY,
Treasurer National Electrical Contractors' Association.

W. H. MORTON,
Secretary Nat[illegible]ctrical Contractors' Association.

Sergeant-at-arms, J. C. Sterns, [illegible]lo, N. Y.

There was very little display of electrical apparatus by the manufacturers, but there was a fine attendance of representatives, among whom the following were present:

George S. Searing, Chicago sales manager, Hart & Hegeman, Hartford, Ct.

W. W. Cheney, Jr., president; Julian S. Jackson, sales manager; A. Benson, secretary, International Electrical Meter Company, Chicago.

G. W. Cooper, district sales agent; Frank E. Johnson, district sales agent, the Ohio Brass Company, Mansfield, Ohio.

John Brooks, sales manager; G. V. W. Ingham, Chicago sales manager, Pass & Seymour, Solvay, N. Y.

I. A. Bennett, W. J. McKenna, I. A. Bennett Company, Chicago.

Sherman M. McFedries, secretary and treasurer; W. R. Harvey, J. L. Schureman Company, Chicago.

J. G. Pomeroy, western sales manager, Adams-Bagnall Electric Company, Cleveland, Ohio.

G. A. Furbeck, Furbeck & Hurt, St. Joseph, Mo.

Arthur O. Einstein, sales manager, Crescent Company, Chicago.

James G. Gilchrist, general manager;

H. W. Markham, sales manager; H. F. Frosch, Federal Electric Company, Chicago.

Frederick L. Merrill, Chicago manager Triumph Electric Company, Cincinnati, Ohio.

George Loring, Shelby Electric Company, Shelby, Ohio.

W. J. Guntz, G. R. Clover, Nernst Lamp Company, Pittsburg.

M. B. Austin, president; W. A. Brown, treasurer; R. J. Thorne, Michigan representative; Arnold H. Friend, M. B. Austin Company, Chicago.

Edwin R. Rockwell, secretary Guarantee Electric Company, Chicago.

C. E. Corrigan, vice-president and general manager; Milton Mill, southwestern sales agent, National Metal Molding Company, Pittsburg, Pa.

Victor L. Crawford, W. N. Matthews & Brother, St. Louis, Mo.

George C. Knott, H. E. Watson, Benjamin Electric Manufacturing Company, Chicago.

H. B. Crouse, president; F. F. Sheel, western manager, Crouse-Hines Company, Syracuse, N. Y.

Homer E. Niesz, manager Electrical Trades Exposition Company, Chicago.

M. F. King, George C. Richards, P. J. Cratty, Richard Wildauer, Thomas Grier, American Circular Loom Company, Chelsea, Mass.

Henry Newgard, president Henry Newgard & Company, Chicago.

J. R. Wiley, J. E. O'Neill, R. S. Hopkins, E. J. Pietzcker, Standard Underground Cable Company, Pittsburg, Pa.

H. D. Haring, O. O. Tucker, M. R. Lash, F. H. Van Gorder, H. W. Dye, H. F. Boardman, J. H. Dutton, G. H. Lounsbery, George H. Porter, H. M. Kennedy, F. A. Henderson, L. J. Baldwin, H. M. Post, E. S. Kiefer, E. H. Peterson, Western Electric Company, Chicago.

E. J. Johnson, Consumer's Rubber Company, Bristol, R. I.

William Low, president; E. R. Field, H. R. Remington, Perry R. Boole, C. A. McCarthy, H. E. Sanderson, A. J. Seltzer, Robert Mitter, Electrical Appliance Company, Chicago.

A. S. De Veau, T. C. Walsh, De Veau Telephone Manufacturing Company, Brooklyn, N. Y.

F. F. Corby, C. W. Larsen, D. L. Markle, Mark Manufacturing Company, Chicago.

U. S. Armstrong, American Conduit Manufacturing Company, Pittsburg, Pa.

[redacted] Bartlett, H. G. Wilson, John A. Roebling's Sons Company, Trenton, N. J.

W. Ennis, manager Pittsburg office, Buckeye Electric Company, Cleveland, Ohio.

Oscar Carman, General Electric Company, Schenectady, N. Y.

W. Johnson, Clark H. Methot, Manhattan Electric Supply Company, Chicago.

C. M. McDonald, Allis-Chalmers Company, Chicago.

P. F. Lyons, National India Rubber Company, Bristol, R. I.

E. B. Kittle, manager Chicago office; Alfred E. Braddell, Harry H. Hornsby, Sprague Electric Company, New York, N. Y.

F. B. Badt, P. A. Westbury, F. B. Badt & Company, Chicago.

Robert Garland, H. D. Hodskinson, H. O. Waterman, Safety Armorite Conduit Company, Pittsburg.

Skyles R. Fralick, Blake Signal and Manufacturing Company, Boston, Mass.

H. M. Frantz, H. W. Johns-Manville Company, New York, N. Y.

E. R. Blyler, Crescent Insulated Wire and Cable Company, Trenton, N. J.

E. W. Kearns, Monarch Electric and Wire Company, Chicago.

W. P. Crockett, Bossert Electric Construction Company, Utica, N. Y.

Maurice Lewison, Detroit Insulated Wire Company, Detroit, Mich.

B. J. Moorenhaupt, Dale Company, New York, N. Y.

A. C. Crockett, Hart Manufacturing Company, Hartford, Ct.

C. D. Gordon, Alphaduct Company, Jersey City, N. J.

James Olson, Habirshaw Wire Company, New York, N. Y.

F. R. Bryant, Central Electric Company, Chicago.

A. I. Appleton, president; John V. Painter, secretary, Appleton Electric Company, Chicago.

Peter F. Hensel, S. H. Couch Company, Boston, Mass.

Charles Mosser, Dearborn Electric Company, Chicago.

A. L. Willard, Westinghouse Electric and Manufacturing Company, Pittsburg.

H. S. Greene, Nungissen Electric Battery Company, Chicago.

J. E. Ham, Waterbury Company, New York.

R. M. Van Vliet, H. P. James, Charles Klien, V. C. Gilpin, Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

Frank N. Jewett, Thomas T. Richards, Wagner Electric Manufacturing Company, St. Louis, Mo.

James Wolff, New York Insulated Wire Company, New York, N. Y.

P. R. Fisher, Condit Electric Manufacturing Company, Boston, Mass.

H. J. Wilms, Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y.

R. L. Thayer, St. Louis Malleable Castings Company, St. Louis, Mo.

F. T. Finney, Western Installation Company, Chicago.

F. D. Phillips, Wesco Supply Company, St. Louis, Mo.

William W. Merrill, secretary and manager; Arthur S. Merrill, Miller Mill, Chicago Fuse Wire and Manufacturing Company, Chicago.

C. R. Wood, R. H. Mills, Moline Incandescent Lamp Company, Moline, Ill.

Harry C. Rice, G.-I. Incandescent Lamp Company, Cleveland, Ohio.

Warren Ripple, president J. Lang Electric Company, Chicago.

George Cutter, president George Cutter Company, South Bend, Ind.

Albert Scheible, president Ajax Line Material Company, Chicago.

American Telephone and Telegraph Company.

Hayden, Stone & Company have prepared a circular giving an exhaustive analysis of the American Telephone and Telegraph Company. The circular says that the company is fully financed for all present requirements, having paid off on July 1, $10,000,000 of American Bell Telephone four per cent bonds maturing on that date, and is now free of any floating indebtedness, and has an excess of $10,000,000 cash on hand. The capitalization, including bonds and notes amounting to $330,484,855, as well as the capital obligations of the subsidiary companies, is represented by property, the replacement value of which, without considering any value in rights of way or franchise or patents, is estimated at $40,000,000 in excess of the entire capital of every kind. The franchises and rights of way are in the greater part permanent, and could not be secured at the present time at any cost within limits. Never since its incorporation in the present form, in 1900, has the company failed to earn its entire fixed charges more than three times over. The circular says:

"No company could possibly attain the tremendous scope of the American Telephone and Telegraph Company, and remain local in any particular. As the American company has become national in the operation of its business, so it must surely become national in the method of its financing and in the demand for its securities. The evident and increasing attraction of its securities will draw capital from all parts of the country, and the shares of the company, already held by 25,000 investors, will become still more widely owned. The inevitable result will be the development of a large and active market for both the bonds and stock of the American company in the financial centre of the country, New York."

The New York, New Haven & Hartford Railroad to Build New Lines.

The New York, New Haven & Hartford Railroad Company has announced that it would expend $1,000,000 on the construction of three new trolley lines. The contracts are to be let at once, and work will be begun on all three lines this fall. One of these lines is to be run from Hartford to Middletown, another from Hartford to Boonfield and the third from Willimantic to South Coventry.

The expenditure on these roads will be the first that the New York, New Haven & Hartford road has made since the financial flurry of last fall, when the company began a policy of retrenchment.

Samuel Higgins, general manager of the New Haven, in discussing the electric system of the road, has expressed his own satisfaction with it and added that the company was well pleased with it. The system was constructed by the Westinghouse Electric and Manufacturing Company, and has a high-potential alternating-current with an overhead trolley.

Mr. Higgins said that the electrification of the New Haven had been so satisfactory in every respect that there had been no thought on the part of the company to substitute another system for the one now in use.

The last payment for the installation, said the general manager, had been made to the Westinghouse company about four months ago, which was further proof of the satisfaction of the railroad company.

SOME ENGINEERING FEATURES OF THE SOUTHERN POWER COMPANY'S SYSTEM.[1]

BY J. W. FRASER.

It has been aptly stated that in order to build a hydroelectric power system there are three fundamental requirements:

1. A sufficient source of power.

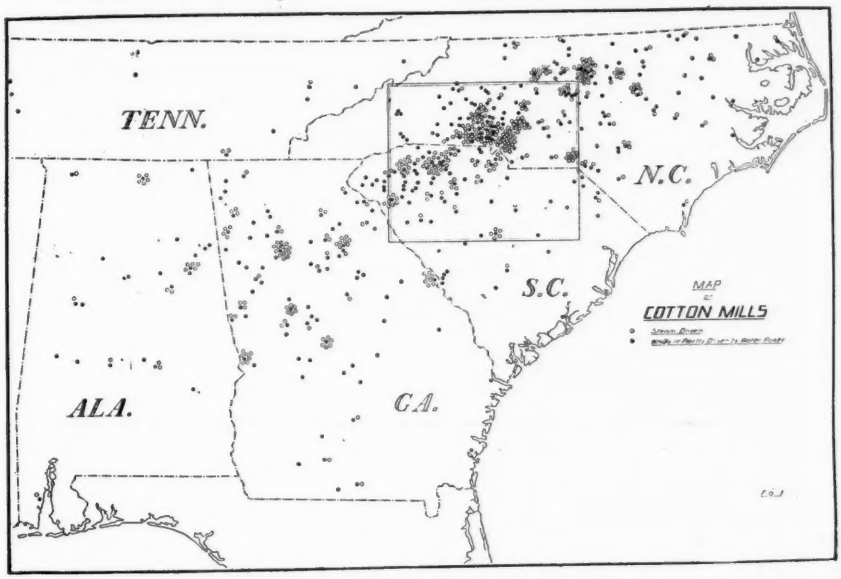


FIG. 1.—MAP SHOWING LOCATION OF COTTON MILLS.

2. A market for the sale of power within economical transmitting distance.

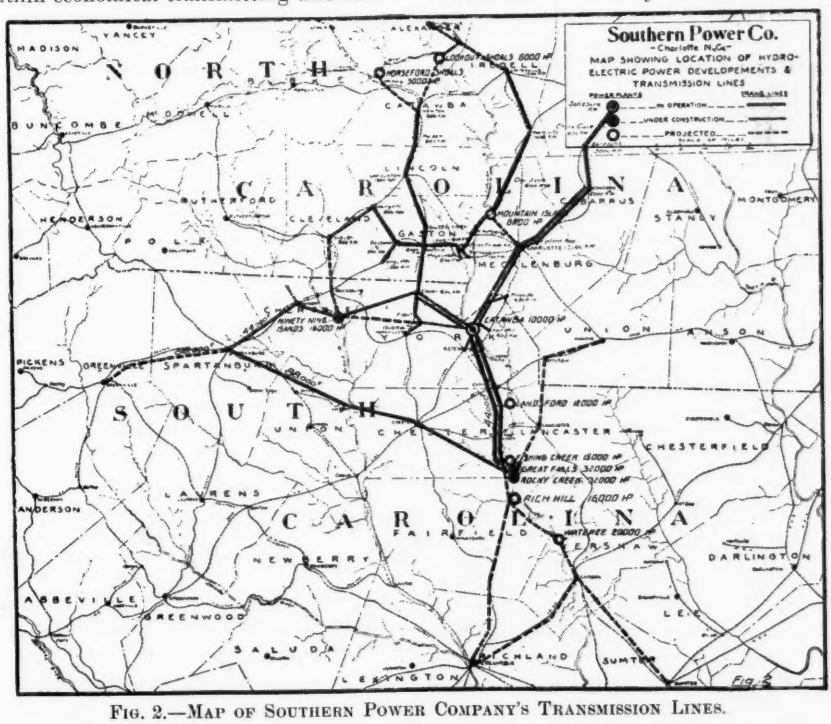


FIG. 2.—MAP OF SOUTHERN POWER COMPANY'S TRANSMISSION LINES.

3. The necessary capital.

It is not the intention of the writer to discuss these three fundamentals in a general way, but to take a concrete example and show how the conditions governing the sale of power must affect the design of the system as exemplified in that with which he is connected; to describe in a general manner this system and proposed ultimate extension of the same.

We will assume for the purpose of this paper a sufficient source of power, as any discussion of the hydraulic conditions would lengthen this paper undesirably. In passing, attention will be called only to the location of the various sites shown on the map, Fig. 2. These aggregate not less than 150,000 horse-power. One only, the Catawba plant of 10,000 horse-power capacity, was partially developed. The nine others are scattered along the Catawba River for a distance of 120 miles, with one on the Broad River about thirty miles west of Catawba station.

In discussing the market at the time when the Southern Power Company was organized (1905), attention is first called to the map, Fig. 1, showing the location of cotton mills in the South, on which is shown a rectangle covering an area of 140 miles north and south by 180 miles east and west, about equally distributed in North and South Carolina. This area is enlarged on the map, Fig. 2. It will be noted that it contains the largest number of mills that can be taken in by any such area in the South. It represents a power consumption of approximately 200,000 horse-power, one-fourth of which is water power. It is all within easy transmitting distance from the various power sites referred to in the above paragraph.

Before investing in these sites a careful investigation showed the average cost of power to be in the neighborhood of $34 per brake-horse-power-year of 3,366 hours; that, although a few of the larger mills had got this cost down to $30, the majority of the smaller mills could not produce power for much less than $40. With coal at $3.50, power could not be distributed for less than $28, even from large central steam stations. Experience acquired from the Catawba station and some smaller stations, to the records of which access was had, showed a fair margin of safety after transmission and other losses were taken into account.

True it is that in recommending investment in these sites it had to be considered that although the electric drive had demonstrated in some instances its reliability, convenience and economy, yet the unsatisfactory history in other instances, the general impression that power was produced for much less than it actually cost, and the fact that mill owners were averse to further investment, would make the sale of power a difficult matter. Still the main question which interested the investor was the cost of steam power, for prejudice could be overcome and the real cost of power could be demonstrated. In a further discussion of the market it is found convenient to treat of it under separate heads embodying the various engineering features.

Frequency—In determining what frequency would best suit the market condi-

[1] A paper presented at the annual convention of the American Institute of Electrical Engineers, Atlantic City, N. J., June 30. For a description of the different power sites owned by the Southern Power Company see ELECTRICAL REVIEW, September 8, 1906, p 367.

tions the following had to be taken into consideration:

a. That the sixty-cycle generators at Catawba station and some 8,000 to 10,000 horse-power in induction motors receiving power from that station would have to be rewound or exchanged, if other than sixty-cycle were used, on account of the fact that separate lines would be too expensive and would complicate matters. Motor generators would make the cost prohibitive, because of the large number of distributing points.

b. That sixty-cycle motors to a total of approximately 8,000 horse-power were driving mills in the vicinity of proposed lines, which load might be obtained, provided the frequency was the same.

c. That there were also quite a few small city plants operating at sixty cycles. At present this might not amount to much, but the growth of these cities had to be considered, particularly in reference to arc lighting. In three years 2,500 arc lights have been put in service and if motor-generators had had to be installed the cost to small mill towns would have been excessive.

d. That a high frequency would give a better power-factor, due to the leading charging current.

e. That twenty-five-cycle generators, transformers and motors would cost at least ten per cent, twenty-five per cent and ten per cent, respectively, more than sixty-cycle generators, transformers and motors.

f. That there was very little prospect in the near future of a rotary converter or railway load, and there were plenty of cotton mills in the district covered to use all the power which could be generated from the rivers.

Against the above is the extra line drop, but when all the developments are completed very little power will be transmitted more than forty miles except over trunk lines where the drop may be taken care of by raising the generator electromotive force. For instance, the voltage at Catawba and at Spartanburg, two centres of distribution, can always be maintained at 44,000 volts.

These considerations seemed to favor sixty cycles, but as exact figures were necessary in this case the following rough calculation was made: The saving in cost of generators and transformers amounted to $75,000, and if the saving in copper due to increased power-factor is added the total will be in the neighborhood of $100,000.

There is an additional loss of about ten per cent of the loss which there would have been at twenty-five cycles and the integrated loss over the present lines when fully loaded will be in the neighborhood of twenty-seven per cent. In power

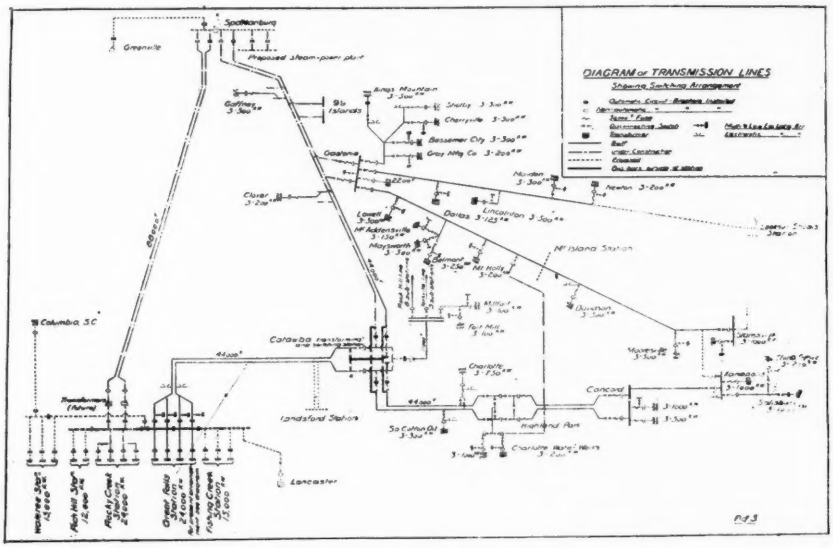


FIG. 3.—TRANSMISSION LINES AND SWITCHING ARRANGEMENTS.

this amounts to ten per cent of twenty-seven per cent of 26,000 kilowatts = 700 kilowatts, which at $5 per kilowatt is $3,500. Capitalized at six per cent this amounts to $60,000—a balance of $40,000 in favor of sixty cycles. It is possible that a very careful analysis might show this loss to be a little greater but the error can not be over twenty-five per cent, as the integrated loss referred to has been taken over a period of six months and covers losses from generators to meters on load. The only other error which could be made would be in estimating the line drop when the present lines were fully loaded, but as the drop on the present load has been measured the error could not be very large.

Considerations (*a*), (*b*) and (*c*) have been left out of the above numerical calculation but might easily amount to several times the figure mentioned.

Voltage—Some of the reasons for keeping the electromotive force as low as 44,000 volts were:

a. That 44,000-volt transformers would cost from eighteen per cent to thirty-three per cent, depending on the size, less than for 66,000-volt transformers.

b. That transformers and switches were more reliable at 44,000 volts.

c. That insulators would cost about eighty cents less each.

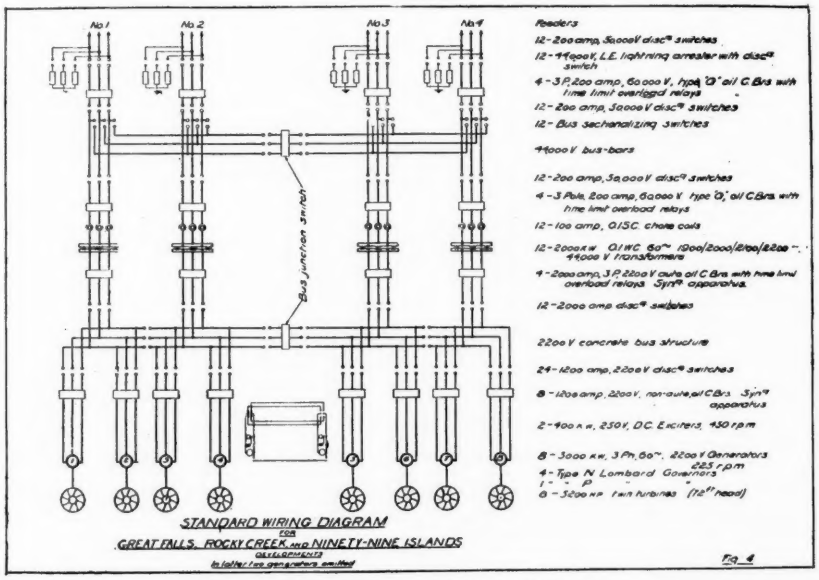


FIG. 4.—TYPE OF STATION WIRING DIAGRAM.

d. That line operation would be more successful.

e. That smaller transformer stations could be built.

It was estimated that the extra copper to give the same drop over the entire system at 44,000 volts as compared with 66,000 volts would not exceed the extra cost of transformers, insulators, substations, switches and other apparatus. The estimate proved correct. With the present 30,000-horse-power load there are on the system 72,000 kilowatts in step-up and step-down transformers and the additional cost if 66,000-volt transformers had been used would have been $64,000; additional cost of 30,000 insulators at eighty cents, $24,000; additional cost of thirty 66,000-volt substations, *i. e.*, twenty per cent on $125,000, $25,000; additional cost of step-up transformer stations, *i. e.*, ten per cent on $200,000, $20,000; a total of $133,000. Against this is the saving in copper in the transmission line had the higher electromotive force been used, roughly, fifty per cent, $130,000.

This shows a saving of only $3,000, but the present lines will carry a great deal more power than they are now carrying, which will increase this amount materially.

One line only of those proposed stands out as an exception, the trunk line running from Great Falls to Spartanburg and thence to Greenville, about 100 miles in length. This line now under construction will be so built that when overloaded at 44,000 volts delivered electromotive force it can be changed to 88,000 volts (*i. e.*, 100,000 volts at generating station). This will be accomplished at a very small additional expense by mounting pins and insulators similar to those now used on our wood-pole lines on the towers as shown in diagram, Fig. 5, for after conversion to a higher electromotive force these pins and insulators can be used on 44,000-volt lines, or this line may be permanently used for local distribution. The intention is that this 88,000-volt trunk-line will not be tapped at any point except Spartanburg. This could be done more easily by using 100,000-volt suspension-type insulators but it is felt that by the time it is necessary to change to the higher electromotive force there may be enough improvement made in these insulators to warrant the extra expense which would be incurred.

Transmission Lines—Further examination of the transmission-line map will show that two-thirds of the obtainable power is in the neighborhood of the Great Falls development, which position was selected as a main switching station, the idea being to mass the output of Great Falls, Fishing Creek, Rocky Creek and Rich Hill at this point on outdoor bus-bars and control the line switches from the operating room in this station.

The generators and transformers were designed to operate continuously at eighty-five per cent power-factor to take care of an induction-motor load, and at 115 per cent normal electromotive force to take care of line drop as the load increased. The main trunk line, from Great Falls to Catawba station, will take care of 20,000 kilowatts at eighty-five per cent power-factor, with a line drop of 13.5 per

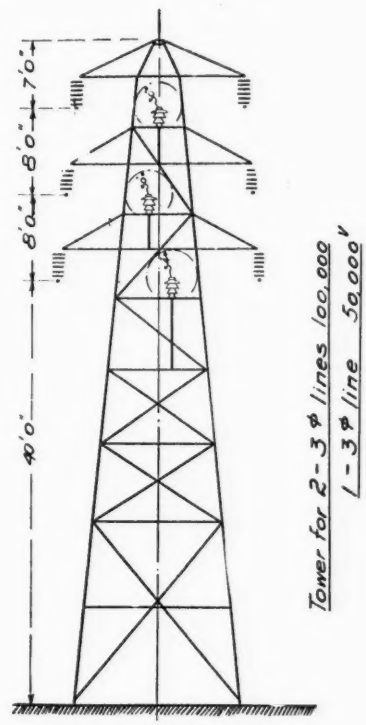


FIG. 5.—88,000-VOLT TOWER.

cent and a loss of 7.25 per cent. This represents the economical section of copper at twenty cents per pound with power costing $5 per kilowatt-year.

It should be pointed out before leaving the subject of transmission lines, that the impossibility of making contracts with mill owners on account of their skepticism with regard to the electric drive, before the greater part of the present lines was actually built, made the estimates on the amount of power to be sold in any one territory so difficult that the location and size of transmission lines could not be determined even approximately. In other words, where and in what amounts power was to be sold was a very uncertain matter.

This brought up the question of wood-pole lines *versus* steel towers. A little consideration showed that if the cost of towers per additional foot in height erected were $7 and copper were at twenty cents per pound, a No. 0 Brown & Sharpe gauge would be the smallest wire which could be strung economically on account of the increased sag in wires below this size for 500-foot spans; that a single-circuit tower line would cost approximately twice as much as a pole line and would last probably twice as long; that a double-circuit tower line would cost very little more than a double-pole line; and that it would be more economical for cotton mills to shut down for a small percentage of time than to pay the additional price for power which would be necessary to cover the extra expenditure for steel-tower lines. It therefore seemed good practice to build main trunk-lines of steel towers and all single lines below No. 0 gauge of wood poles.

Still another factor increased this difficulty. One large development under construction and several others recently financed by competing companies tended to make mill owners hold off for better prices. I refer to this merely to show how such a matter may affect the design. Considerable discussion resulted as to whether Great Falls and Rocky Creek should not be made into one development by means of a canal and pipe-lines. This would take at least as long again as to develop one source and would cost the same as separate developments.

(To be concluded.)

Extensive Trolley-Terminal Plans.

Plans were made known on July 16 for a new trolley terminal in Jersey City, which, it is said, would be one of the largest in the world. The terminal will be operated in connection with the tunnel system to Manhattan, and work on the improvement will be started in a few weeks.

It is planned to draw many of the New Jersey trolley lines to a point in Exchange Place, Jersey City. An underground passageway will run from the tunnel station to Exchange Place. A half dozen loops will be laid for the cars and sheds will be built. Trolleys from almost every district in Hudson County will be brought to the terminal.

Another transfer point in Jersey City may be at Henderson street and Newark avenue. It is proposed to divert several main lines to the point, thus enabling passengers to gain time in reaching the McAdoo tunnel.

Annual Convention of the American Institute of Electrical Engineers—III.

Report of Concluding Sessions, Thursday, July 2.

THURSDAY MORNING SESSION.

THE seventh session of the meeting of the American Institute of Electrical Engineers, which was held at Atlantic City, N. J., June 28 to July 2, inclusive, was opened on Thursday morning, July 2, at 9.30 o'clock, with President Stott in the chair.

The reports of the preceding sessions were given in the issues of the ELECTRICAL REVIEW for July 4, 11 and 18.

Dr. C. P. Steinmetz read a paper entitled "The General Equations of the Electric Circuit." Due to our incomplete knowledge of the phenomena resulting from the stored energy of the electric field, we are greatly hindered in a practically unlimited extension of high-potential transmission and distribution. The study of these phenomena represents the most important problem of electrical engineering. Dr. Steinmetz has been investigating the general equations of the electric circuit and here presents his first results. The work is still incomplete and in some instances may require modification. The paper represents an attempt to investigate mathematically the phenomena which may occur in the most general case of an electric circuit.

Dr. Steinmetz said that the investigation was incomplete, but brought out some important facts. One is that the general equation of a circuit shows that it may be considered as having two electric waves moving in opposite directions, each of which gives rise to a reflected wave. Another point is that when a transition takes place from one part of the circuit to another having different characteristics, there is both a voltage and a current transformation, and since both at the point of transition must be identical, there must be a sudden change in phase. In concluding, Dr. Steinmetz said that from what has already been done, he thought it safe to predict that in a few years we shall be able to treat the transient phenomena of electric circuits with as great accuracy as we can now deal with simple alternating currents. When we are able to do this we will be in a far better position to handle those disturbing effects on transmission systems which he calls lightning, and these will probably lose their terrors.

Dr. F. Bedell said that one great value of Dr. Steinmetz's classic paper was his interpretations of his own results. This is often neglected in such analytical studies. He pointed out that in the general case the current may not be the same in all points of the circuit, and said the hydraulic analogy might be applied to the general case by substituting an elastic tube for the rigid pipe. He pointed out that different components travel at different rates along the line, and this is the reason distortion takes place in telephone circuits.

D. C. Jackson said that in looking over Dr. Steinmetz's paper many old friends reappear, but there are also new equations which go much further than the old ones. He thought the best analogy for the general case was a vibrating string having different characteristics at different parts, these corresponding to different values of inductance and capacity.

Dr. Charles P. Steinmetz presented a paper entitled "Primary Standard of Light." In this it is pointed out that since light is a physiological effect, and not a physical quantity, it can not be measured in absolute physical units, but must be measured by comparison with an arbitrarily chosen standard of physiological effect. As a result of this, even the difficulties of reproduction and of maintaining its constancy are such as to involve errors very far beyond those considered permissible in physical measurements. A radical increase in the accuracy of reproduction and maintenance of a primary standard of light appears possible only by relating the standard of light in such manner to physical quantities that it can be determined by energy measurements. This led to the recommendation of defining the primary standard of light by the energy of radiation; but this requires a definition of the quality of radiation, since the physiological effect of radiation has no direct relation to the energy of radiation. Moreover, the physiological effect is not merely a function of the quality or color of the light, as lights of the same intensity and color—that is to say, physiologically identical—may be entirely different physically and represent different amounts of power. The power of the visible radiation is, therefore, not a measure of light. For this reason the definition of the absolute unit of light as the effect of one watt of power of visible radiation requires an arbitrary definition of the distribution of power throughout the visible range. Such a standard of light might be that given by black-body radiation at a different temperature and included between certain wave-lengths of the spectrum, but Dr. Steinmetz does not think that such a standard would be satisfactory, because the intensity of the red end of the spectrum is too high, the physiological effect too small, the absorption constant of glasses is different for different wave-lengths, any deviation of the radiator from black-body radiation offsets the result, and the color of the light would be yellow and not white. He thinks a more satisfactory primary standard of light, based on measurement of radiation power, can be produced by selecting three primary colors of the visible spectrum. Let these colors be of definite wave-length, about equally distant from each other, and of such character that they can be absolutely reproduced at high intensity; such, for example, as the spectrum lines of a luminous gas. Then define the unit of light as that given by one watt of power radiated at these three wave-lengths in different proportions, chosen so as to give white or yellow-white light. The primary unit of light may be taken as the physiological effect produced in this way. Such a standard requires three sources of monochromatic radiation which can be maintained constant with any desired exactness. The mercury-vapor lamp constitutes such a source. By properly adjusting the current density in the mercury-vapor lamp, three bands may be picked out: one in the violet, one in the green and one in the red, which are about equally distant. These are the lines having respectively the wave-lengths 43.55, 54.6 and 69.1 microns. To obtain them two low-temperature mercury lamps will be required for the blue and green and one high-temperature quartz lamp for the red. These could be maintained at constant radiation by maintaining the currents constant and also the condition of ventilation and surrounding temperature. By properly selecting the proportions of these colors, a white or, better, a yellowish-white light could be fixed upon as a standard. Such a selection of colors would give an exact numerical expression

of the physiological color of any light by defining the ratio of three intensities of the primary elements.

A communication from Dr. W. S. Franklin was read, which said that the plan proposed by Dr. Steinmetz was novel and important, and he suggested that the Bureau of Standards, at Washington, take up the proposed standard and see whether it could be employed with any success. He did not expect complete success, as the inherent errors in any photometric measurements are too large.

Carl Hering said he was pleased to see the scientific standard of light proposed based upon the unit of power. He pointed out several advantages of the standard, one being that it did not require the determination of a new mechanical equivalent.

Dr. C. H. Sharp thought that the proposed standard gave promise of offering a general solution of the problem of devising a standard of light. He referred briefly to some of the other attempts, particularly that proposed by Violle, which depends upon the light emitting from a given area of molten platinum at the moment of solidification. He questioned whether such a mixture of monochromatic light as proposed would give the same color as a corresponding mixture of polychromatic light.

J. B. Taylor asked why Dr. Steinmetz had used the wave-length of the light waves for the scale of abscissas. The wave-length depends upon the medium, while the frequency is absolute and should therefore be employed. He asked also why Dr. Steinmetz had used the musical analogy in arranging his scale of colors. Pitches are recognized in sound, but not in color.

Dr. E. B. Rosa thought it would be a good plan to make a trial of Dr. Steinmetz's proposed standard, for even if the attempt to secure a satisfactory standard was unsuccessful, the investigation would be worth while for its own sake. He said the work was clearly one suitable for the Bureau of Standards.

Dr. H. S. Carhart pointed out that the proposed plan made use of three different wave-lengths, giving rise to three distinct sensations. He called attention to the fact that this method of mixing colors was entirely different from that of mixing colored pigments.

Mr. Hering then moved that the convention recommend to the board of directors the presentation of this proposed standard of light to the Bureau of Standards for investigation. The motion was carried.

Dr. Steinmetz, in closing the discussion, said that he had selected red and blue lights which were equidistant from the green, as this seemed to be the logical method of procedure. Regarding the criticism of his scale of abscissas, he had merely followed custom, as, of course, the proper factor to be considered was frequency and not wave-length. The mixture which he proposed would probably produce a yellowish light, and the proper proportion of colors to give a pure white light would probably be about fifty-five per cent of red, fifty-five per cent of green, and minus ten per cent of blue. Put in another way: The color of the mixture which he proposed as a standard would probably be identical with pure white light if ten per cent of blue be added. Referring to a statement which had been made that the value for the mechanical equivalent of light indicated that with an efficiency of 100 per cent we should get five and one-half candles per watt, Dr. Steinmetz said more recent researches had indicated that the true equivalent was probably 0.018, or something over fifty candles per watt for pure white light.

The paper by Carl Hering on "An Imperfection in the Usual Statement of the Fundamental Law of Electromagnetic Induction," which was read before the Philadelphia section of the Institute, on February 10 last, and which was discussed in the ELECTRICAL REVIEW for March 21, was brought up for discussion and a number of communications were read. The experiment consists in passing a loop formed of two springs attached to a galvanometer circuit over the pole of a horseshoe magnet and then drawing it off across the middle. The first movement gives a deflection; the second does not. Dr. C. P. Steinmetz considered the paper interesting since it called attention to a looseness in the form of expressing the law of electromagnetic induction which is frequently the cause of serious misunderstanding and the waste of much energy and time. This is illustrated in the many attempts to invent a coil-wound homopolar machine. The experiment described is not startling, as the reverse case—the continuous production of electromotive force without any change in the number of interleakages of the circuit with the magnetic flux—is illustrated in practically every unipolar machine. Maxwell's law is an integral expression derived from the general or differential law by integration over the whole circuit under the terminal or limit conditions of continuity of conductor and continuity of motion, and does not apply to Mr. Hering's experiment or to the general design of unipolar machines which do not fulfil the conditions of continuity of motion, but have parts of the conductor sliding over other parts. Faraday's expression is the general law, but in its application to unusual cases it must be kept in mind that the line of magnetic force is merely a pictorial representation of the magnetic field in space as characterized by two constants—intensity and direction. This pictorial representation, when carried so far as to apply to its physical existence, may lead to wrong conclusions; for instance, when discussing whether the lines of magnetic force of a revolving magnet move with the magnet or stand still. In such a field, if the intensity and direction do not change, the field is constant regardless of the motion of the magnet. Unfortunately, in teaching, instead of the general law of induction, there is frequently given to the student its specific application to the term of the closed continuous conductor as more convenient to illustrate and understand. While this is permissible in giving an elementary introduction for a complete understanding, it should be supplemented by an exact discussion of the general induction law; that is, the mathematical formulation of Faraday's pictorial representation.

Dr. A. E. Kennelly does not think that the experiment is in disagreement with either Faraday's or Maxwell's statement of the law. Maxwell's specifically rules out the case of multiple-connected regions, and when the law is stated it is inherently assumed that the circuit is not interrupted and re-established around a new boundary. In Mr. Hering's experiment this is practically what is done. The experiment shows, however, that the cutting of the flux is the primordial conception, and it is well to remember that this electromotive force occurs as much in insulators as in conductors, although it is only revealed in the latter case. In Mr. Hering's experiment the law is juggled by changing it from a simple connected to a multiple connected space, which is not permissible.

Dr. Elihu Thompson accepts the views expressed by Dr. Kennelly, holding that the slipping of the clips over the leg of the magnet virtually opens the circuit, inasmuch as an immovable section of the conductor is substituted in the gap where all the flux to be cut then exists. There seems to be one universal law which may be expressed as follows: "It is not possible, without chemical or thermoelectric action, to generate a continuous current in a closed circuit without sliding contacts"; or, to put it in another way, "A magnetic induction machine for direct

currents must have a commutator or sliding contacts of some sort." Although apparently some such rectifying action might be secured by means of the change in resistance of selenium, due to its exposure to light or bismuth, due to its exposure to a magnetic field, such effects would be rather pulsating than rectifying.

Dr. W. S. Franklin, while agreeing in general with Mr. Hering, will not admit that Maxwell's statement of the law is not strictly correct. He does not think that those who accept Maxwell's generalization have forgotten the ideas of the actual cutting of lines of force, but it may be that they are likely to be led to forget this because of Maxwell's statement. Although we are obliged to think of one variable only changing at a time, we should never forget that all things may change together.

Percy H. Thomas said that the experiment is not conclusive, as the slipping of the springs over the magnet practically cuts off a portion of the circuit. The same view is held by G. T. Hanchett.

W. P. Graham believes it is open to question whether Maxwell's statement of the law is sufficiently precise, and he thinks that the cutting of the flux by the conductor is the point to be emphasized if Faraday's statement is to be preferred.

R. E. Hellmund, in a paper on "The Graphical Treatment of the Rotating Field," evolved diagrams by means of which nearly all the phenomena of the rotating field may be easily studied and the various factors necessary for the calculation of flux, exciting current, etc., are exactly determined. He develops diagrams for the fluxes in the individual teeth, for the space values of the total field, the potentials, time values of the total field, the equivalent sinusoidal field, showing the characteristics of the rotating field, the reactive effect of the secondary, and shows how the different coefficients may be deduced from these and the values thus found used in practical calculations.

C. A. Adams expressed his appreciation of Mr. Hellmund's paper, as the diagrams which the latter had developed show clearly the various relations existing in the motor. Such studies are good, not only for the student, but for the designer as well, because they give a visual picture of what is going on. In closing, Mr. Hellmund said that one of the difficult parts of the problem is the study of magnetic leakage and the determination of this factor.

Harold Pender presented a paper entitled "A Minimum-Work Method for the Solution of Alternating-Current Problems." The complex forms for impedance and admittance render the formulas for most alternating-current problems exceedingly complicated and numerical calculations become extremely tedious after the first and second operation. To avoid this a simpler method is desirable, and the one here described makes use of certain factors, namely, the ratio of the reactance to the resistance, which is called the reactance factor, and the ratio of the resistance to the impedance, called the power-factor. Introducing these factors into the expressions for the different quantities reduces them to simple forms and greatly lightens the labor of solving problems. The use of this method is illustrated by applying it to a number of alternating-current problems.

The discussion was opened by P. H. Thomas, who said that he did not think Mr. Pender's method and the use of the factors which he proposed would save much labor, but that his careful tabulation should be given the credit for lightening the work.

C. A. Adams said that he had used a similar method without, however, making use of the two factors proposed. He did not think that such short-cut methods were desirable for students' use, as the latter are then apt to lose sight of the true relations. They are, however, of value when there are a number of similar problems to be solved.

C. J. Fechheimer, in a paper entitled "The Relative Proportions of Copper and Iron in Alternators," discussed those features in the design of alternators which affect this ratio. The early generators were designed by rule-of-thumb methods, and the relative proportion of copper to iron was high. These machines had poor regulation and gave way to the so-called iron machines, in which the proportion of copper was less than that of the copper machines and the regulation was better, but the design more expensive and heavier. Hence it was endeavored to develop a cheaper design without sacrificing good regulation. This is the stage which has been reached to-day, and it demands an intimate knowledge of the results of previous work and careful balancing of the conflicting factors. The author derives equations for the weights of the principal parts of the alternator, the weight in each case being easily expressed as some factor which is easily determined, multiplied by some power of the flux per pole. The weight of these parts is then multiplied by the price per pound of material used and certain other factors introduced to allow for waste and for parts not included in the equation. The sum of these costs will give the cost of the material and the principal parts of the machine in terms of the flux, and it can then be determined what value of flux will give the minimum cost of the material. This being known, the rest of the design follows at once. The method is illustrated by the design of an 800-kilowatt alternator.

W. L. Waters, while expressing appreciation for such studies, said that machine design is an art rather than a science, and there is little real value in such academic studies. Past experience is the best guide in actual design.

C. A. Adams, while admitting that past experience must be depended upon to guide the designer, said that a general analysis of the different factors entering into the design is always of value and should help to reduce materially the amount of cutting and trying.

The session was then adjourned.

THURSDAY AFTERNOON SESSION.

The eighth and concluding session of the convention was called to order Thursday afternoon, July 2, at two-thirty o'clock, by President Stott, and three papers dealing with educational topics were presented in abstract.

M. W. Alexander presented a paper entitled "A New Method of Training Engineers." This calls attention to the desirability of giving the college student practical experience at the same time that he is following the theoretical studies. After some years' experience with the student course offered by the General Electric Company, at its Lynn works, Mr. Alexander has come to the conclusion that the best way of giving this practical training is to combine it with the theoretical work. The colleges should confine themselves strictly to teaching theory and underlying principles, and the student should alternate between the college and the shop. This should go on for four years and the entire senior year should be given up to theoretical work. This method is being tried at the University of Cincinnati, but Mr. Alexander thinks that the length of the period selected there—one week—is too short. The proper length can only be determined by experience.

D. B. Rushmore, in a paper entitled "The Relation of the Manufacturing Company to the Technical Graduate," discussed those qualities of the young engineer which render him most valuable to the manufacturing company. Naturally the man who has had a college training is more efficient than the one who has not,

and the ranks of industrial concerns are now largely filled with college graduates. The importance of the technical organization is insisted upon, and it is thought that one of the most promising signs of the times is the close study and co-operation between manufacturers and colleges.

A suggestive paper, entitled "The Relation of the Manufacturing Company to the Technical Graduate," was read by B. A. Behrend, chief electrical engineer for the Allis-Chalmers Company. Mr. Behrend says that the qualities necessary for a man to rise to a high position in an engineering company are integrity, moral courage and intellect, and while there are many possessing any one of these qualities, there are few who possess all three. Yet it is such men that the manufacturing companies are looking for. He thinks that in supplying such men the colleges are doing remarkably well, but they are not always supported in the right direction by the manufacturing companies. The latter should not seek the man, but force the man to seek a position, thus not giving him an exaggerated opinion of his own importance. There is, unfortunately, among the colleges and graduates a most ominous disdain for painstaking accuracy and devotion to laborious detail which are so essential to all really great work in engineering. The wish to take up the work of some one else and make it a commercial success is easily explainable, but not so easily excused. This condition is really a menace to the stability and continued prosperity of manufacturing interests which must be remedied lest it produce a far-reaching result in discouraging graduates from the pursuit of new and important creative engineering work. Those who have been engaged in the building up of large manufacturing organizations have been impressed with the fact that the absence of moral qualities frequently mars a successful career, as frequently, perhaps, as the absence of purely intellectual qualities.

Before the discussion was taken up, the usual resolutions of thanks to the convention committee for the excellent arrangements it had made for the visiting members; to the Philadelphia section for its assistance in making the convention a success, and to Mr. Gummey, the proprietor of the Casino, who had allowed the Institute to make use of it for the reception Monday night, were adopted.

President Stott announced that, according to custom, Percy H. Thomas, the chairman of the papers committee, had tendered his resignation, and that A. H. Armstrong has been appointed chairman of the new committee. President Stott then thanked the various committees for their excellent work during the year.

The discussion on the three papers which had been read was opened by Professor J. P. Jackson, who said that if the results obtained by the training given in technical colleges are not satisfactory, the manufacturing companies have themselves to blame. They should get in close touch with the engineering departments of these colleges, find out what they are doing, and if they do not approve of the work as conducted, they should not hesitate to criticize. The manufacturers, however, should take care that they do not crowd out the so-called culture courses entirely in the technical work. Professor Jackson said that part of the blame for the present conditions must be laid on our general educational system. The study of history deals mainly with political movements and wars; it neglects scientific progress and the engineering work of the countries with which it deals. He suggested a number of subjects which might be profitably included in the engineering courses, such as railroad economics, labor problems, economic geography, etc. One method of improving the engineering courses, which is now to be tried, consists in appointing a number of consulting professors—men who are not engaged in teaching—whose duty it will be to advise with the department regarding the work to be taken up and the method of presenting it.

Mr. Behrend said that the co-operative courses recommended by Mr. Alexander and Mr. Rushmore could be adopted at but few colleges. Moreover, there are comparatively few manufacturing establishments at which the student really learns a great deal. He is more apt to be put to some manual work, such as drilling holes in name-plates, and kept at that for months without any opportunity to increase his knowledge of the process of manufacturing. One serious objection to such courses would be the prevention of concentration. No important problem can be solved in a week, or even a month, and to oscillate the students between the college and the shop would simply fritter away their time without giving them any thorough training. His criticisms were not directed toward the trade schools, which are necessary, but he thinks the co-operative courses would be a mistake for the college of high standing. He said frankly that the suggested plan would be one of the most vicious and dangerous innovations that could be made at a university.

P. H. Thomas believes that more commercial work is necessary to give the student true appreciation of the value of costs. The best way to secure this would be to overlap the last end of theoretical study with the first part of practical work. There is, however, a chance of overdoing this. It would not be safe to cut out shop work from the technical school, because it is there that the student learns the reason for the best methods. To send the students into the shop would distract their attention from theory and concentrate it on the commercial side. This would be dangerous.

Professor Morgan Brooks said he looked at the subject from the side of the technical school. The object of the school is to train men in character, and it would be difficult to do this if the student were oscillated from college to shop and back. For example, all colleges encourage athletics, but no student taking such co-operative courses as had been proposed could take any part in athletics at the college. There would also be much difficulty in administration with such co-operative work, particularly when special courses are offered. He thought it was a good plan for the students to enter some shop during the summer and possibly to take one year off and devote it to practical work, but these periods should not be less than one-half of the college year. He thought that a man who has done good practical work would have done still better work if he had had a college training.

Secretary R. W. Pope said he thought the Institute might profitably devote some of its energies to the training of parents. Few parents to-day seem to know what to do with their sons, and try to throw the responsibility for selecting their profession on the Institute or elsewhere. Moreover, the greater number of the members of the Institute could improve their own work by giving more attention to minor details. There is hardly an associate who applies for transfer to full membership in the Institute who seems capable of filling out properly the application blank.

Professor H. H. Norris said that the college work must necessarily be arranged for the average student, but unfortunately the average student prefers to work with his hand rather than his head. The favorite position in laboratory work is holding speed. A co-operative plan such as proposed would cause a severe loss of time when changing from one occupation to

another. There is generally about a week lost after every term in college work, and to overcome this it had been suggested by the faculty of Sibley College, Cornell University, to break up the year into two long terms without any vacations at all, long vacations being allowed between the terms. Professor Norris thinks that the students are apt to lose interest in the theoretical work if their attention is directed greatly toward practical problems. They should be given just enough practice to enable them to think. The shop work must be kept at the college, as that is really the preparatory laboratory of the manufacturer.

Dr. Steinmetz said that from the college professor's standpoint, instruction in practice is desirable, but there is not time enough for it. The question, therefore, is not to teach what is desirable, but to teach what the student can not learn elsewhere. Hence the main effort should be to ground him thoroughly in science and give him a broad general culture. It is no criticism of the college to say that it does not turn out men fitted to drop into commercial positions. Indeed, he would suspect the training given at a college which claimed to do this, as it could only be done by omitting essentials. What the college should do is to make the students understand that upon graduation they have really only begun their work. The technical colleges are not the only educational institutions at which practical work may be taught, as there are trade schools which devote their entire time to training in the various trades. Then come the correspondence schools, which do work of a little higher class, and do it well. Next come the technical schools, which should carry the training of the men still further. There is one serious defect in the schools offering higher education: this is the inefficiency of the system, as the effort is made to work up the entire mass of material into engineers, although but few of them are really capable of developing into good engineers. In this way time and effort are wasted and the good men are neglected. Dr. Steinmetz spoke of the foreign colleges, particularly the German schools, where instruction is offered in every possible subject, but the responsibility for learning it is thrown upon the students. In this country, on the other hand, the college assumes a good part of this responsibility. The result of this is that American colleges produce few leading engineers. Far better results would be accomplished if the men were sorted out more stringently.

Professor D. C. Jackson said that the question is physiological and psychological. There is as good material to-day for producing such men as Watt and Newcomen as there was in the early days of the steam engine. He thinks that there is need for real professional education—that is, education similar to that given to law and medical students. These men first obtain their general college course and then attend a school where their entire time is given to professional studies. He thought in the future that we would have to depend upon the great engineering schools for producing the leaders. Professor Jackson approved of Mr. Alexander's plan and did not think it necessary to have the shop near the school. This matter could be adjusted. There should be closer co-operation between the manufacturers and the schools.

Professor C. A. Adams said that Mr. Alexander's scheme was being tried. The result remained to be seen. He did not take the same view of professional schools as did Professor Jackson, for at the law schools the students study cases and do not argue them; and at the medical schools they attend clinics, but do not operate. There is another difference which should not be overlooked. When the medical student is given his degree he must be equipped to be able to take the responsibility of his patients' lives, while the technical graduate is not required either to be responsible for life or for the success of the company with which he first connects himself. The plan advocated by Dr. Steinmetz is being tried at Harvard, as the students are allowed to take a general course in science or arts, obtaining the A. B. or B. S. degree in three years. After this they enter the Lawrence Scientific School as graduate students and obtain the engineering degree.

Professor Albert F. Ganz said that Mr. Alexander's plan would cut down the study of theory to three years by the elimination of laboratory work. This can not be cut out if Dr. Steinmetz's plan is to be followed. The first two years should be given to scientific instruction, and only in the third year should much time be devoted to practical questions. He asked President Stott whether he would like to have Mr. Alexander's plan applied in his power stations so as to give the students experience in the operation of large electric plants. To this suggestion Dr. Steinmetz interjected that the experience would certainly be good for Mr. Stott.

Charles F. Scott said that the discussion seemed to overlook the most important feature of the college education. The aim of this is to develop men of character and power, not to turn out men manually dexterous. There is need of great teachers to develop the proper type of man. The study of theory and practice must go hand in hand, and if the time lost in changing from one to the other is not too great the plan proposed would be good. The object of the college courses should be to turn out men thoroughly trained, and not graduates plastered with learning.

G. S. Dunn said that his experience had shown that the best graduates had usually had some practical experience. He thought that the students should come in contact with manufacturing methods before graduation. The discipline and training in the shop are good, and even if the men are kept at drilling nameplates for months, this is in a sense military training. If the man has any ability he will be able to pick up, while drilling, a great deal of useful information. He did not think it was necessary to have the college work and shop work as intimately mixed as Mr. Alexander's plan, and for this reason he was opposed to it. The college graduates are better than the other men, because of the discipline and experience which they have had. There would be some difficulty in applying Mr. Alexander's method generally, as it would be necessary for all factories in the country to take some of these students, while not all of them are in shape to do so.

E. R. Taylor said that one phase of the general problem should not be overlooked. At present we have good manual training schools in the cities. Such schools should be established in all the smaller towns, and they should be depended upon for selecting men for the technical colleges.

This completed the discussion on the educational papers, and then resolutions were adopted sympathizing with Dr. F. A. C. Perrine on account of his illness, which had lasted during the entire convention.

J. H. Finney spoke of the necessity for teaching the general public the great need for conserving the natural resources of the country. He quoted Speaker Cannon as saying recently that there is but one grain of wheat to the bushel of chaff of what the engineers have said. Mr. Finney said that if every member of the Institute, particularly those connected with local sections, would see to it that the true need for conserving our resources was appreciated by all with whom they had any influence there would soon be a good deal more than one grain of wheat to the bushel. He urged every member of the Institute to become a missionary in this work, and said he hoped that the engineers of the country would become the leaders in the movement.

The business of the convention having thus been completed, President H. G. Stott declared the convention finally adjourned.

ELECTRICAL CONTRACTORS' OPPORTUNITIES IN THE ILLUMINATING FIELD.[1]

BY GEORGE LORING.

What is the position of the electrical contractor in the field of artificial illumination and how may he extract profits therefrom? Lamp manufacturers devote their time to building illuminants with the highest attainable commercial efficiencies in hundreds of different sizes and styles to meet every conceivable lighting condition. Central stations generate and sell, at the lowest possible cost, the energy necessary to operate the lamps. The electrical contractor may profitably see that the public, the consumer of the lamps and the current, is made aware of every convenience and advantage which may be secured by their proper use, and is thoroughly posted as to the economical methods of producing a most satisfactory illumination at the lowest total cost. Lamp manufacturers, central stations, electrical contractors and the consumer should work in harmony. It is to their advantage to always have one another's welfare at heart.

HOUSE-LIGHTING SUGGESTIONS.

A plan, the carrying out of which gives much satisfaction and is also extremely economical to the consumer and creates business for the contractor, is the equipping of many parts of a domicile, whether it is or is not already electrically lighted, with fourteen-watt (three-candle-power) carbon lamps in addition to the larger ones which are always installed. Small lamps may generally be operated only when any of the sections in which they are located are not occupied. Larger lamps should naturally be out of service at such times. The utilization of fourteen-watt lamps will result in decreasing the number of rooms and halls now left in darkness after dusk, especially when the family is away for the evening; thus adding to the general comfort and appearance of the home and to the safety and security of the people and property therein.

As an example, showing how these small illuminants will work out, we will take a nine-room, three-story house which has a piazza in front. A fourteen-watt (three-candle-power) lamp equipped with Holophane reflector No. 2,677 and placed seven feet above the veranda, one foot out from the middle of the front door, will produce an illumination with an intensity of 0.2 foot-candle upon the centre of the door, making, in the majority of cases, the number thereon, if there is one, and there always should be, distinctly visible from the street. The fourteen-watt lamp will also sufficiently light, during the cold evenings, the piazza, the steps, and at least a portion of the path leading up to same. The imprint, shown in Fig. 1, with an illumination upon it of 0.15 foot-candle, may be read by the average person at a distance of eighteen inches. This will give an idea of the amount of illumination necessary to make clear from the highway a number upon a house.

Copper declined 5s in London with spot closing at £58 and futures at £58 10s. The local market was dull and unchanged with lake quoted at $12.87½@13.00; electrolytic at $12.62½@12.87½ and casting at $12.50@12.62½.

FIG. 1.

There should also be located over the centre of the piazza a large lamp, such as a forty-watt tantalum or tungsten or a fifty-watt metallized-filament, which could be used when people are sitting upon the veranda in the summer and care to read or desire a higher illumination for any other purpose.

We will suppose that there is a hall, living room, library, dining room and kitchen on the first floor of this house. When any of these sections is not occupied, a fourteen-watt lamp could always be burning therein at a very low expense between the hours of dusk and the time the party retires.

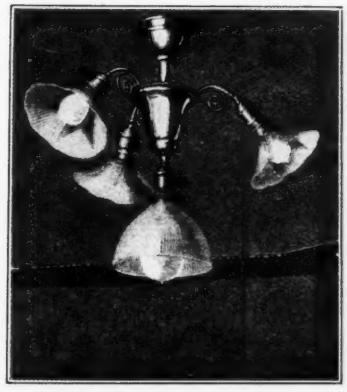


FIG. 2.—LIGHTING FIXTURE IN LIVING ROOM.

In the hall on the second floor a fourteen-watt lamp may be left burning all night and will also be found to give a sufficient light the majority of the time when it is necessary to have artificial illumination. The same may be said regarding a fourteen-watt lamp in the bathroom. In these places there should also be lamps of sufficient luminosity to furnish a higher illumination when necessary.

It costs only one-seventh cent an hour to operate a fourteen-watt lamp when current is ten cents per kilowatt-hour. It will therefore be seen that when the family is not using the first floor of this house, low-candle-power lamps, giving a surprisingly satisfactory light, may be operated in the hall, living room, library, dining room and kitchen for five-sevenths cent per hour, and may be in service in the hall and bathroom of the second floor at a cost of only two-sevenths cent per hour, and that one of these illuminants may be left on in the hall of the second floor all night at an expense of burning from 10 P. M. to 7 A. M. of one and two-sevenths cents.

We will assume another case where these low-candle-power lamps may be used to good advantage. Imagine a six-room apartment, consisting of a living room, two bedrooms, a hall thirty feet in length, dining room, den, kitchen and bathroom. Let the living room, dining room, hallway and bathroom each be equipped with a fourteen-watt lamp as well as a larger one. When any of these places is occupied, the large-candle-power lamp should be operated, the small-candle-power lamps being in service in the other sections. The bed chambers are off the hall and will naturally receive a small amount of light if their doors are left open. By following out this plan you have an illumination practically throughout the dwelling, and persons desiring to go from one place to another do not have to hunt around in the dark for a switch before making their way about. The home is also far more cheerful, as instead of certain parts being dark and gloomy, it is all comfortably lighted. The fourteen-watt lamps in the living room, hall and dining room may be left on any evening, when the home is temporarily deserted, at an expense of three-sevenths cent per hour. This is certainly a most cheaply acquired protection against theft.

In planning the lighting of a house utmost care should be used in placing lamps where they are most needed and employing only those which are efficient to the highest degree commercially and are equipped with accessories which will aid them in producing the necessary illumination at the lowest total cost. The accompanying illustrations show several inexpensive, highly efficient fixtures which may be used respectively in the living room, hall, dining room and a compart-

[1] Abstract of a paper read before the National Electrical Contractors' Association, Chicago, Ill., July 15.

ment, which, for lack of another name, we will call a den.

The living room is fifteen by twenty feet. The lighting fixture is hung from the centre of the ceiling, as is shown in Fig. 2. The lamp placed in a vertical position and suspended from the end of the fixture has its centre of luminosity eight feet above the floor. It is a forty-watt tungsten, bowl frosted, equipped with Holophane reflector No. 6,046. With the tungsten lamp alone in service, the light directly from it produces an intensity of illumination upon the floor, at any place within a radius of seven feet from a point directly under the tip of the lamp, of from 0.3 to 0.4 foot-candle. This illumination is at least doubled on account of the light reflected from the walls, the reflecting coefficient of which is not less than 0.5. The direct intensity of illumination upon a book or table placed two and one-half feet above the floor, and located within a radius of five feet from a point under the tip of the lamp would be from 0.6 to 0.8 foot-candle. This illumination would be doubled by wall reflection. In other words, from this one lamp

Fig. 3.—Hall Light.

we receive a uniform illumination of high intensity over a large area. When no one is in the room the tungsten lamp is not operated and one of the fourteen-watt lamps, which will be seen upon the arms of the fixture, is lighted.

In the hall, placed as high as possible above the floor and suspended from the centre of the ceiling, is a fixture (Fig. 3). This is only a temporary device, but it demonstrates how easily a small and a large-candle-power lamp may be installed in one bracket. In this case the results are most satisfactory. The large lamp is a forty-watt tungsten, which gives an excellent light throughout the hall, the length of which is thirty feet. The small (fourteen-watt) lamp is used alone for low illumination, and at such times there is a sufficient light to allow everything in the hall to be plainly seen. It will be noticed that a Holophane reflector is used

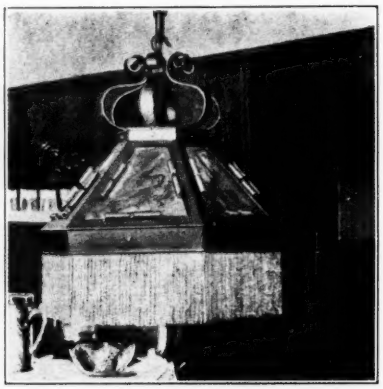


Fig. 4.—Dining Room Light Fixture.

also with this lighting unit. The adoption of this accessory, when correctly located, increases the ordinary illumination of the lamps at least forty per cent.

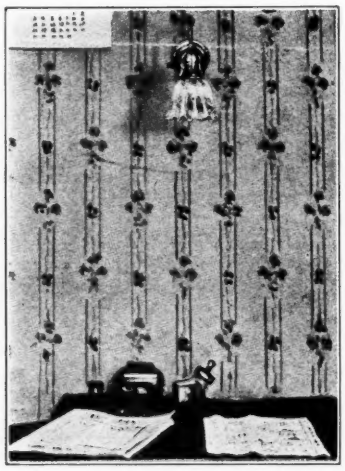


Fig. 5.—Den Lighting Fixture.

Fig. 4 shows a fancy dome used over the dining-room table. Enclosed within the dome is a fourteen-watt lamp and also a Holophane No. 6,045 reflector, used in conjunction with a forty-watt tungsten lamp and nearly hidden from view when parties are seated at the table. The reflector is employed for the purpose of preventing the great waste of light which would take place if all the upward rays from the lamp were allowed to come into contact with the glass of the dome. This glass would, on account of being highly colored and fairly thick, absorb about eighty per cent of the light which fell upon it and only part of the remaining twenty per cent would be reflected downward upon the table, whereas, by the use of the Holophane reflector the dome is made sufficiently bright, and the mean lower hemispherical candle-power of the tungsten lamp is increased forty per cent. In lighting this dining room, which is fifteen by eighteen feet, the intention is to have an illumination of as high intensity as is comfortable upon the covering of the table, which, by reflecting the light falling upon it will cause the rest of the room to be satisfactorily illuminated.

The den is seven by ten feet. The paper has a reflecting coefficient of about 0.6. Upon the centre of one of the narrow walls, and five feet above the floor, is a bracket supporting an eight-candle-power lamp and Holophane No. 245 reflector (Fig. 5). This reflector (Fig. 6) has one side consisting of prisms intended to reflect light and one side made up for diffusing light. It is the first side mentioned which is placed toward the wall on which the bracket is mounted. The result of the combination of the eight-candle-power lamp and the reflector is that the intensity of illumination upon a table located under the lamp is at least three foot-candles, and the candle-power in the direction of the wall nearest to the lamp is from only one-half to one-third of that in the direction of the opposite wall. The sum and substance of the whole matter is that by means of this reflector the horizontal light, which has only a short dis-

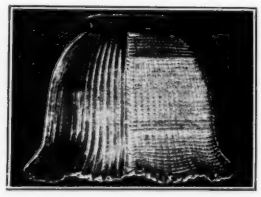


Fig. 6.—Special Reflector.

tance to go before lighting a part of the area to be illuminated, and the upward light, of which only a small amount is necessary, is curtailed, whereas the horizontal rays, which have to travel the greatest distance, as well as those in a downward direction, which are most useful, are increased, and last, but not least, the light is properly diffused. With few exceptions, I do not advocate illuminating by wall brackets. When such fixtures are already installed, however, they must be used to the best advantage.

Electrical contractors to-day have greater opportunities than ever for profitably working out lighting advantages in dwellings. On account of the introduction of the tungsten lamp and also most

efficient reflectors, houses may be better illuminated, whenever high illumination is necessary, with a material decrease in meter bills. By causing those now using electric lights to be better satisfied they become stronger advertisers for electricity, which will mean more business for the central station and the contractor.

STORE LIGHTING.

If the standard of illumination in the dwelling of a business man has been raised there will be little difficulty in getting him to listen to a plan to change his store lighting.

When replacing carbon with tungsten lamps the endeavor should be made to install two forty-watt tungsten units for every three sixteen-candle-power carbon lamps displaced, provided the installation is as efficient as is possible with carbon-filament lamps. This method increases the illumination thirty-three and one-third per cent, and at the same time makes a net saving of twenty per cent on total lighting expense when current is six cents per kilowatt-hour. Net saving, in this instance, means that if a party using carbon lamps is receiving them free, the saving on lighting will amount to twenty per cent after deducting the price of the tungsten lamps, provided that current is six cents per kilowatt-hour.

If a person is illuminating his store by means of gas or gasolene lamps, his business should be secured through the medium of tungsten illuminants, installed either in units consisting of one lamp with proper reflector, or with tungsten clusters. Tungsten arcs containing either five sixty-watt or three 100-watt lamps will give a more satisfactory illumination than a Welsbach four-burner gas arc. With gas at $1 per 1,000 cubic feet, the expense of operating tungsten clusters will be no greater if current is seven cents per kilowatt-hour. Two 100-watt tungsten lamps will produce better results than a four-burner Humphrey gas arc. In this case the cost of lighting will be no greater with the tungsten lamps when current is nine cents per kilowatt-hour and gas $1 per 1,000 cubic feet. The initial lower mean hemispherical candle-power of a four-burner Welsbach gas arc is under normal conditions 281 candle-power. There will be a drop in candle-power, however, of twenty per cent within the first 100 hours and thirty-three and one-third within the first 300 hours of service. In other words, at the end of 100 hours the mean lower hemispherical candle-power will be 225, and at the expiration of 300 hours 188 candle-power. Under normal conditions, during its life, which averages 800 hours, a tungsten

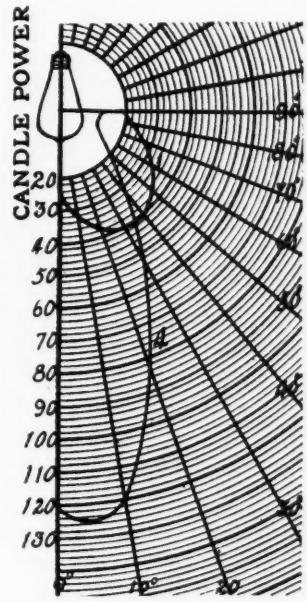


FIG. 7.—VARIATION IN DISTRIBUTION OF LIGHT WITH CHANGED POSITION OF REFLECTOR.

lamp does not drop more than ten per cent, and will therefore produce better illumination from the quantity standpoint and a clean pure light of superior quality.

GENERALITIES REGARDING LIGHTING BY ELECTRIC INCANDESCENT LAMPS.

It is most important, in order to do electric lighting justice, that the right reflectors be employed with the lamps and their relative position be correct. Untested reflectors and shade holders should not be used in a haphazard fashion.

The curves on Fig. 7 show the great variation in candle-power distribution and illumination resulting therefrom caused by simply changing the relative position of the reflector to the lamp.

Curve 1 is the candle-power distribution of a forty-watt, bowl frosted, tungsten lamp with a B2 crimped Holophane reflector in a given position. By bringing the reflector one and one-half inches nearer to the tip of the lamp a distribution such as is shown by Curve 4 is produced. This change of one and one-half inches in the relative position of this particular reflector to the lamp increases the candle-power in the direction of the tip 460 per cent. At all other angles up to approximately fifty-eight per cent the candle-power is greater than it was before. Between thirty-eight per cent and ninety per cent, however, it is materially lessened. Curves 1-D and 4-A (Fig. 8) show the intensities of the illumination received upon a horizontal plane within a radius of sixteen feet of a point directly under the tip of the lamp when it is suspended vertically over and has its centre of luminosity ten and twelve feet, respectively, above the plane illuminated, and when the candle-power distribution is the same as that shown on Curves 1 and 4 respectively. It will be seen that the intensity of the illumination as shown by curve 1-D is practically even upon a horizontal plane within a radius of five feet from the point directly under the lamp, and that if this radius is increased two feet the intensity of the illumination within that radius is very even, the ratio between the maximum and minimum being as 3:2. Curve 4-A, although depicting the intensity of illumination produced by the same lamp used with the same reflector employed to secure the illumination represented by Curve 1-D, and with all other conditions similar with the exception of the position of the reflector being altered one and one-half inches and the lamp being raised two feet higher above the objective plane, shows an illumination which is extremely uneven, the ratio of the intensity of the illumination at the point on the plane directly under the lamp compared to that

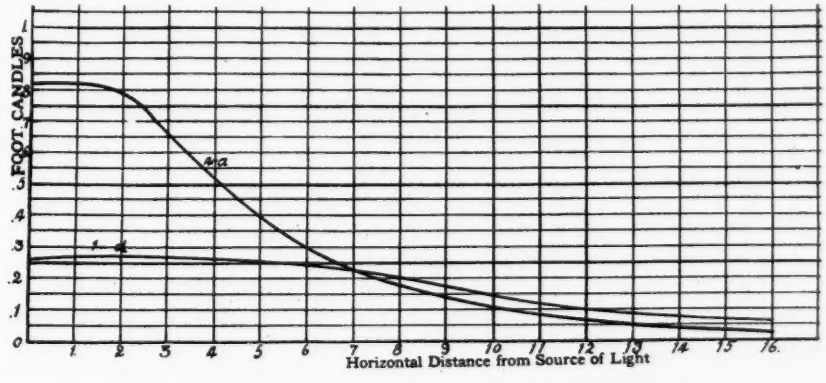


FIG. 8.—INTENSITY OF ILLUMINATION ON HORIZONTAL PLANE.

upon the plane eight feet from the point just mentioned being as 100 : 24. Lighting units having a candle-power distribution as shown by Curve 1 should be located with the distance between them equal to 1.2, 1.5, or two times their height above the objective plane to produce an even illumination upon it.

Fig. 9 represents a plane to be illuminated by lamps located with their centres of luminosity ten feet above it, the distance between them being fifteen feet. The reflectors upon the lamps are placed in such a way that each lighting unit has a candle-power distribution similar to that shown in Curve 1, Fig. 7. The intensity of illumination upon the Plane A-B, Fig. 9, when only two lamps, namely, those directly over *a, b* are in service, is from 0.31 to 0.4 foot-candle. The intensity of illumination upon Plane A-B, when the lamps over *a, b, c, d* are in use, ranges from 0.37 to 0.44 foot-candle. The intensity upon Plane A-B, when lamps over *a, b, c, d, e, f, g, h, i, j, k, l* are operated, is from 0.54 to 0.61 foot-candle. The illumination upon X produced by the illuminants over *a, b, c, d, e, f, g, h, j, k* is 0.576. The illumination upon Plane Y-Z, from lamps over *s, y, r, z* and *e*, is from 0.4 to 0.5 foot-candle. The area of the plane illuminated is 5,644 square feet. Total watts used in lighting it are 1,220; watt per square foot, 0.21, and the watt per average foot-candle, 0.36. No reflection from sources other than the reflectors used with the lamps has been taken into consideration in figuring the foot-candles upon the objective plane.

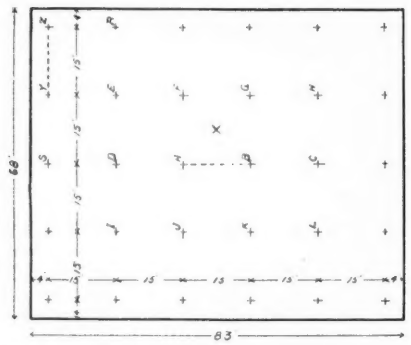


FIG. 9.—ILLUMINATION FROM VARIOUS LIGHT SOURCES UPON HORIZONTAL PLANE.

It should be the aim of every one endeavoring to produce satisfactory illumination to have its intensity, with few exceptions, highest and apparently equal and uniform upon the objects most necessary to be seen. All surfaces other than those of such objects, being of secondary importance, should, if possible, be more lowly and to a certain extent unevenly illuminated, thus forming a background for that which it is desirous to make most conspicuous and eliminating the possibility of flatness in the lighting scheme. In the majority of cases the illuminants themselves should be of such a character and so located and equipped as to make their presence absolutely unfelt.

The sale of lamps is but a small part of the work of the electrical contractor. Ofttimes it is impossible for him to sell them owing to the lighting companies furnishing carbon lamps free and disposing of tungstens at less than cost. Even when this is the case the profits of the contractor may be materially increased by giving proper attention to the lighting of stores or homes. There is no reason why he can not work in sufficient harmony with the central station so that he may secure orders for practically all materials for furnishing light, with the exception in some cases of the lamps.

The contractor should give to his customers the illuminants which are the most economical (based on lamp and operating cost combined), not necessarily the longest lived. After the lamps are sold the contractor should endeavor to see that they are properly placed and most efficiently equipped. Give a man the best which can possibly be obtained for his money, show him how he can add to his personal home comforts or increase his business through the proper equipment and use of many lamps, which at the present time he does not understand, and it will be found that the lighting end of the business, which has probably had very little attention, will be bringing in a most profitable revenue.

Condemns New York City Fire-Alarm System.

The report of the commissioner of accounts, dealing with conditions in the New York city fire department, condemns the present fire-alarm system as obsolete and a menace to the city and recommends that it be replaced by thoroughly modern apparatus.

The estimated cost of the proposed new fire-alarm system, as given in the report, is $2,680,000.

The danger that the city's fire-alarm system might be entirely put out of commission in event of a fire or other serious mishap at fire headquarters, where the main or central office is located, is pointed out in the report.

In addition to recommending an up-to-date alarm system the commissioner, to obviate the danger at headquarters, suggest that the "central" alarm station be installed in the southern part of Central Park, or, if that should prove objectionable, in the neighborhood of Fifty-ninth street.

Experiments on a Directive System of Wireless Telegraphy.

A. Tosi on May 22 read before the London Physical Society a joint paper by himself and E. Bellini on the above subject, in which they described the results obtained in the course of their work upon a further development of their original directive system.[1] In their earlier method it was not possible to say from which side of the receiving station the transmitted waves arrived, for though the radiation was practically confined to the plane of the aerial system, it was emitted equally in the opposite direction to that desired.

In the new unilateral system, it is said, the waves are sent in a single direction only, and the problem of getting rid of the backwardly extending radiation has thus been solved. The method adopted consists in superposing a bilateral directive system, as previously described, upon an ordinary or vertical antenna system. Since the two half-diagrams of the directive aerial are opposed in phase, it follows that when the two systems (directive and vertical antenna) are simultaneously excited and in phase, the one half of the directed radiation will add itself to, and the other half subtract itself from, the radiation due to the vertical-antenna system. The diagram of the vertical-antenna system being a circle, the resultant diagram of the superposed systems will, for the case where these are in phase as regards excitation, be a cardioid whose maximum radius vector is double that of the diagram of the directive system alone. Since then the directive system is able to vary the direction of its maximum emission by means of the radiogoniometer, it follows that by moving the position of this latter it is possible to shift the direction of the resultant emission represented by the cardioid, in a corresponding manner. Several energy diagrams obtained by means of the thermogalvanometer are reproduced in the paper, and these show that, even where the excitations are not exactly in phase, the only result is a slightly less good diagram. Diagrams of the scheme of connections employed during the taking of the energy diagrams are also given.

The same principle of the superposition of the two systems has been applied to the case of the reception. In this case a phase displacement of ninety degrees in the excitations is produced in a suitable manner and in this way, when the pointer of

[1] See ELECTRICAL REVIEW, May 9, p. 727; July 18 p. 101.

the radiogoniometer is directed, say, toward the transmitting station, the reception is a maximum, while when turned at 180 degrees from this it is a minimum, or zero. Diagrams of received energy and of the connections employed are also given in this case.

The system of unilateral directive wireless telegraphy now described by the authors is of special interest owing to the facility with which it is possible to change over from one system to the other, thus, from the ordinary vertical-antenna system to the bilateral directive or the unilateral directive, or *vice versa*. The aerial arrangements, moreover, remain exceedingly simple. When a message from a station of unknown position is expected, the vertical-antenna or ordinary system would be employed; on once effecting reception, one can pass to the bilateral or unilateral directive system and thus determine the direction and on which side the transmitting station lies, at the same time making oneself independent of other transmissions. In the same way, with the transmission, the vertical antenna would be employed for calling up an unknown station or for simultaneously sending to several stations; on once getting a reply the operator can then readily determine the position of the receiving station, with the aid of the unilateral system, and thenceforth will transmit solely in that direction.

The authors further called attention to the advantages which such a directive system offers in the case of the commercial services, as well as for military and naval purposes.

A discussion followed in which Dr. J. A. Fleming, Dr. W. H. Eccles and W. Duddell took part.

Dr. Fleming, after congratulating Bellini and Tosi on their skill and inventiveness in the investigations, said that the experiments confirmed, in many ways, his own theory of the operation of a bent antenna as employed by Mr. Marconi. When Marconi described his experiments on directive telegraphy before the Royal Society in March, 1906, he gave no theory in the matter. Dr. Larmor pointed out then that an antenna partly vertical and partly horizontal was equivalent to the sum of a magnetic oscillator and an electric oscillator. Shortly after, Fleming went more carefully into the matter mathematically and showed that the observed effects could be accounted for on that theory. Both Marconi and Fleming had obtained by the same methods as Bellini and Tosi the same type of pear-shaped radiation curves by combining the effects of closed and open oscillators. Although Dr. Mandelstam had lately criticized this theory there did not seem to be sufficient grounds for objecting to it. Marconi had long employed directive antennæ in Poldhu and Clifden power stations, and had also given demonstrations showing that the position of ships out of sight could be located by means of such receiving directive antennæ. Nevertheless, Bellini and Tosi had worked out extremely ingenious arrangements for determining the direction of the radiant point without moving the antennæ themselves. Fleming said that he had also shown that, having the power to locate the radiant point, two stations equipped with such antennæ at a known distance apart could, by simultaneous observations, determine also the distance of the radiant point, and this might become important in connection with marine work.

Dr. W. H. Eccles warmly congratulated the authors upon their original and beautiful method. On this method, by merely rotating a small coil of wire on the table, a fixed aerial directive system of any size was made to do what could otherwise only be done by turning the whole system of aerial wires in azimuth. The essence of the system was the piece of apparatus styled the radiogoniometer, which, by causing appropriate component radiation from two fixed wire triangles set at right angles, brought about a resultant radiation in any direction desired—just as if a virtual aerial of the full size of the fixed aerials were being rotated in the air. Someone had compared the result so achieved with that obtained by Marconi's well-known arrangement of a number of fixed bent antennæ with their horizontal portions directed from a centre to various points of the compass.

The looped aerials used by the authors did not seem to the speaker to be the best kind of radiator for utilizing the principle they had developed. The radiogoniometer would prove to be capable of giving excellent results with two fixed antennæ of the best type set at right angles, one, for example, in the meridian plane and the other in the east-west plane. The two looped aerials of the authors may each of them be assimilated to a pair of vertical antennæ emitting waves of 180 degrees phase difference, and with the assumption that for a single vertical aerial the inverse square law holds for the propagation of electrical effects from a single aerial, the speaker showed by aid of the ordinary equation of wave-motion that a looped antenna obeying the condition stated emitted two waves of equal period, of phases differing ninety degrees and 180 degrees, respectively, from the phase of the radiation from either side of the loop, and of amplitudes having a ratio proportional to λ/x. This means that one portion of the resultant radiation obeys an inverse square law and the other portion an inverse cube law; the latter portion is the more important of the two when the distance x is small; the former is the more important when the distance x is much greater than the wave-length λ. This explains why Dr. Fleming's measurements of the radiation from closed oscillators, which were carried out at short distances, gave small promise of powerful propagation to a distance, and why Bellini and Tosi had found as a fact that good propagation occurred to great distances.

As regards the phases of the two portions of the radiation, the important portion for wireless telegraphy, namely, that obeying the inverse square law, was ninety degrees out of phase with the near side of the loop; and thus it is clear that the vertical aerial the authors had used to cancel the radiation to one side of the sending station, must for that purpose emit radiation ninety degrees out of phase with the near side of the loop. Bellini and Tosi had reached this conclusion in the course of their experiments.

After eliciting that the power-supply to the primary of the induction coil for the Dieppe-Havre experiments was 500 watts, Dr. Eccles concluded by remarking that the authors were worthy of special congratulation because in their method of unilateral transmission by phase and intensity adjustment of several radiators they had eluded the difficulties of managing the phases that had apparently baffled F. Braun when he was using the same principle.

Mr. Tosi, in reply to Dr. Fleming, stated that Braun's cardioid diagram was a theoretical diagram only; the method had not succeeded and no actual diagram obtained experimentally had ever been shown.

Referring to the similarity which Dr. Fleming said the pear-shaped diagram of Marconi bore to the authors' diagrams, Mr. Tosi could only say that they had purposely shown some bad diagrams as well as some good ones. The good diagram of Marconi's corresponded to the authors' bad diagram. With the Marconi horizontal aerial it would, moreover, be necessary, as Dr. Eccles had pointed out, to employ 360 such wires to obtain an accuracy in locating the bearing of the radiant point equal to that secured with the system now described. Further, if the emitted energy is actually represented by Marconi's pear-shaped diagram, it is difficult to understand why the transatlantic messages from Clifden to Glace Bay are readily picked up off the Algerian coast, at right angles to the line of transmission.

In reply to Mr. Duddell he said that the wave-length of the waves employed was from 350 to 400 metres.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Town Refuse as Fuel for Generating Electricity.

At a recent meeting of the Incorporated Municipal Electrical Association of Great Britain an address was delivered by Herman Talbot upon the conditions affecting the operation of electric generating stations. During this the speaker touched upon the operation of refuse destroyers in conjunction with generating stations and referred particularly to the performance of the Easteroft destructor at Nottingham, England, which destroyed 28,302 tons of refuse last year, producing therefrom 1,069,885 kilowatt-hours. The wages of the men in the destructor plant amount to $10,730. The output averaged 240 kilowatts. As, however, this output could have easily been supplied from the generating station itself, the wages paid to the operators were unnecessary from the point of view of the station. The cost per kilowatt-hour thus produced was about 0.96 cent, which would more than pay for the additional steam which the load would have used. The destructor runs from fourteen to eighteen hours a day with a load-factor of twenty-eight per cent and generated nine per cent of the total electrical energy supplied to the city. This seems a creditable performance, but it must be remembered that the destructor station of necessity supplies the cheap units at the bottom of the load curve and leaves to the main station the task of supplying the expensive ones at the top, with a consequent reduction of the latter's load-factor. It thus seems, from the station point of view alone, that a destroyer plant is not a desirable auxiliary, but since the destruction of refuse by burning is the most effectual method, and since this cost of burning must be borne whether the heat be utilized or not, it would be a pity not to utilize it even if in so doing the electrical system contributes indirectly toward the expense of the destruction.—*Abstracted from Mechanical Engineering (London), July 3.*

Motor-Driven Wheatstone Transmitter.

One of the valuable factors of the Wheatstone telegraph system is the ability which it gives of rapidly sending messages over a single wire. Thus, in case of breakdown of a line, the entire office force may be set to punching messages and transmitting them at four times the speed over the one or two wires which may remain in service. The system as in use to-day has altered but little since it was introduced by its inventor. A number of improvements might be suggested, one of these being the substitution of a keyboard perforator and another a better method of driving the transmitter. The latter is usually driven by clockwork, which necessitates continual rewinding, thus disturbing the attention of the operators. This method is somewhat inflexible, as it is not easy to change the speed of the transmitter when this becomes desirable. The substitution of a small electric motor for the clockwork drive was suggested some years ago, but it does not seem to have been applied satisfactorily. In this article, C. C. Vyle and E. V. Smart describe a motor drive which they have developed for this purpose. The motor is rated at one-sixteenth horse-power and operates at 110 volts. It is series wound and has a German silver plate fixed at one end of the axle. This is made rigid and is used as a friction plate. On the front of the friction plate rests the edge of a friction disc, consisting of two thicknesses of compressed hide held tightly between two metal discs. The hide only touches the friction plate. A ball is held by springs against the end of the armature remote from the friction plate, forming a thrust-bearing. This holds the plate firmly at constant pressure against the disc. On the axle of the friction disc is the gear driving the transmitter. To vary the speed of driving, the friction disc is traversed across the plate, the change in speed being continuous. By placing the disc a little out of line with the centre a slight force tending to move it toward the centre of the wheel is set up, so that it is only necessary to provide a screw holding the disc away from the centre. This arrangement gives any desired speed and the series characteristics of the motor enable it to run up to its operating speed quickly.—*Abstracted from the Post Office Electric Journal (London), July.*

Wave-Form Analysis.

A discussion is given here by P. M. Lincoln of the Fischer-Hinnen method of analyzing wave forms. This system is based upon the following theory: If three ordinates of a sine wave be erected 120 degrees apart, their algebraic sum is zero if the curve be a pure sine wave. The same is true for any five ordinates, provided the interval between them be seventy-two degrees. In the same way it holds for n ordinates, provided the distance between them be 360 degrees divided by n. If a third harmonic wave be imposed upon this sine wave the algebraic sum of three ordinates taken 120 degrees apart is no longer zero, but is equal to three times that of the ordinates of the third harmonic. One ordinate of the third harmonic may thus be determined, provided no multiple harmonic of the third be present. They may, however, be allowed for by a suitable correction. In the same way an ordinate of the fifth harmonic or of the seventh may be obtained. The method of determining these harmonics consists then in finding two ordinates of each, ninety degrees apart. These values are sufficient to determine the complete curve of each harmonic. The ninety degrees difference between the two values must be measured in terms of the harmonic considered. Knowing these two values any maximum value is found by taking the square root of the sum of the squares of the two. The tangent of the arc subtending the angle representing the difference in phase between the harmonic and the fundamental, measured in terms of the harmonic, is given by the ratio of the two ordinates which have been found. The sign of this ratio determines the direction in which the harmonic crosses the axis of abscissas. Mr. Lincoln gives a general formula which can be used in determining any harmonic by substituting the proper values as measured from the wave being steadied. In applying this method to electrical work the even harmonics are usually absent and need not be looked for. If the wave is symmetrical about its maximum ordinate, the solution is somewhat simplified, as this means that all harmonics cross the base line at the same point as the fundamental. Under

this condition but one set of ordinates need be determined.—*Abstracted from the Electric Journal (Pittsburg), July.*

A Simple Duplex Telegraph System.

A simple duplex telegraph system—that is, a system enabling two messages to be sent simultaneously in the same direction over one wire—is described here, which, in addition to its simplicity, is independent of the weather conditions, there being no necessity to balance up an artificial line against the varying resistance of the transmitting line. The system requires, at the sending station, two ordinary Morse keys connected in independent circuits between the line and the ground, each circuit including a battery. A third circuit connected in parallel with the two ground connections of the keys contains a resistance and a third battery more powerful than either of the other two. At the receiving station there are two receiving instruments, one of which is a simple sounder operated by a polarized relay responding to positive current impulses. The second is a similar sounder, connected, however, in the opposite direction, so that it responds only when its local circuit is broken. This may be accomplished by either of two relays, both of which are polarized. One responds to weak negative current impulses, and the other to strong positive impulses. In operation when either key of the sending station is closed it sends a relatively weak positive or negative impulse over the line, according to which key is depressed, and this impulse causes the corresponding relay at the receiving station to respond. Should both keys be depressed at the same instant this will send a strong positive impulse over the line, actuating, of course, the relay which responds also to weak positive impulses and that one in the second receiving circuit which responds only to strong positive impulses. Under this condition both sounders at the receiving station would respond. To secure operating conditions it is necessary to have the battery which comes in operation when both keys are depressed sufficiently powerful to operate both relays. When one key alone is depressed this battery does not send an impulse over the line, because at that moment it is short-circuited through a resistance and the other key, the potential thus thrown upon the line being insufficient to overcome the opposed working battery.—*Translated and abstracted from L'Industrie Électrique (Paris), June 25.*

Portable Type of High-Frequency Alternator.

A discussion is given here by R. A. Fessenden of a small high-frequency dynamo, built for use in wireless signaling. The machine was constructed to give an output of one kilowatt, but it was found that it could carry considerably more. It is approximately twelve inches high, and, including the steam turbine which drives it and the governor, is nearly three feet long. The diameter of the rotating field disc is six inches; that of the steam turbine disc is three and one-half inches. The original design was for a machine developing 250,000 cycles a second, but as it had been found that a frequency below 90,000 would give a much better range of transmission during the day the design was altered so as to give 100,000 cycles. The machine will normally run in the neighborhood of 75,000 cycles a second. For the lower frequency a steam pressure of 100 pounds per square inch is used in the turbine. To obtain the highest frequency the steam pressure required is about 135 pounds. The specifications call for constant operation for twenty-four hours without attention and this test has been passed successfully. The oiling arrangements are automatic. At present the alternator gives about 225 volts on open circuit, at 75,000 cycles, with an armature resistance of five ohms. The available output of the machine is about two and one-half kilowatts at this frequency. The excess of this output over what had been expected is due to conservative design and considerably smaller friction and windage losses than had been anticipated. These two losses aggregate about three kilowatts, but they may probably be reduced to one-half this amount by slightly modifying the design. Theoretically this machine can develop four kilowatts at the high frequency, but the field shaft is too small to carry this load. The machine is of a double-armature type, there being 300 coils on each armature; the field has 150 teeth. The two field air-gaps are approximately one-sixteenth inch in length. The machine runs absolutely without vibration. For speed regulation it has been found impossible to depend upon the governor of the usual type. For this purpose the Fessenden resonance speed indicator is employed. The method of controlling the generator consists in connecting it in a circuit attached to the antenna. This circuit is tuned to about one-twentieth of one per cent higher than the desired frequency. In this circuit is a dynamometer having two contacts which govern an electrically controlled throttle valve in series with a sensitive reducing valve in such a way that if the frequency increases one-twentieth of one per cent, the needle touches one contact and cuts down the speed. If the frequency falls by the same amount, the reverse operation takes place. By using a larger amount of inductance in this circuit, an air condenser and a low-resistance dynamometer, theoretically the speed might be kept constant within approximately one-fiftieth of one per cent; but this close regulation has not been obtained in practice. The best so far secured is one-twentieth of one per cent. By this arrangement any desired frequency is quickly obtained by setting the indicator to the proper value when the circuits automatically alter the speed for the dynamometer until the desired frequency is reached. In special cases a safety device, consisting of an additional tuned circuit arranged so as to be in resonance at a frequency about five per cent higher than that of the governing circuits, is used. Should the frequency reach that resonant with this circuit, a signal will be given or the dynamo automatically stopped. The alternator is used for transmitting signals by running it at that frequency which produces resonance in the receiving circuit. When a signal is to be sent a key is depressed which alters the frequency of the alternator about one-twentieth of one per cent, thus producing beats in the receiving instrument. This change in frequency is accomplished instantaneously by electrical means, it being, of course, impossible to change mechanically the speed of rotation. The advantage of this method is that the machine is operated continuously, generating waves of the same intensity which at their high frequency have no audible effect on any neighboring station. For a signal to be received, the receiving circuits must be adjusted so that these beats due to a slight difference in frequency will be produced.—*Abstracted from the Electrician (London), July 3.*

London Tube Finances.

The English Chancery Court on July 16 sanctioned the scheme for the readjustment of the finances of the Underground Electric Railway Company as approved by the shareholders at a meeting held in London, May 11. This plan provides for the issuance of various bonds aggregating $46,000,000, the amount necessary to this end.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

The International Electric Meter Company's Measuring Instruments.

Within the last few years there has been developed by the International Electric Meter Company, Chicago, Ill., a high-grade line of alternating and direct-current voltmeters and ammeters. This business was started in a very small way by first placing upon the market a direct-current, switchboard-type voltmeter and ammeter. This line of instruments to-day consists of approximately twenty-five different types of measuring instruments, which include switchboard and portable voltmeters and ammeters, besides pyrometers, automobile and special school laboratory types of instruments. Illustrations of some of these are shown herewith. New features are continually being developed and placed upon the market.

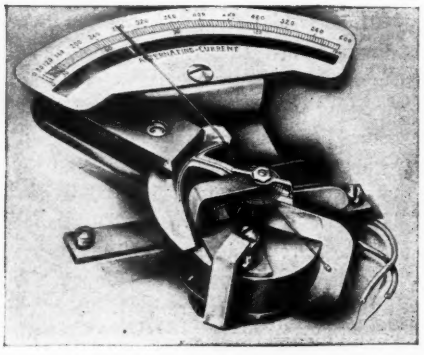


FIG. 1.—ALTERNATING-CURRENT INSTRUMENT, READY TO MOUNT IN CASE.

FIG. 2.—ALTERNATING-CURRENT INSTRUMENT COMPLETE.

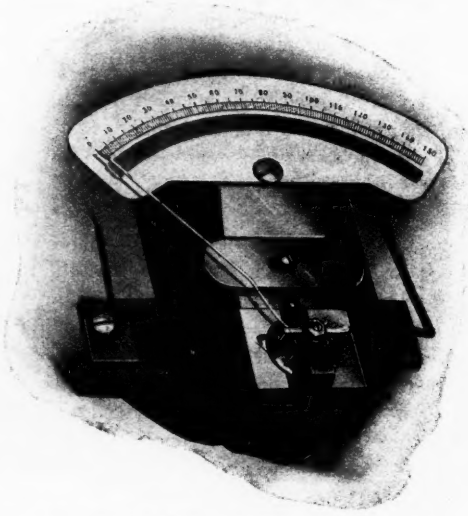


FIG. 3.—DIRECT-CURRENT INSTRUMENT, READY FOR MOUNTING IN CASE.

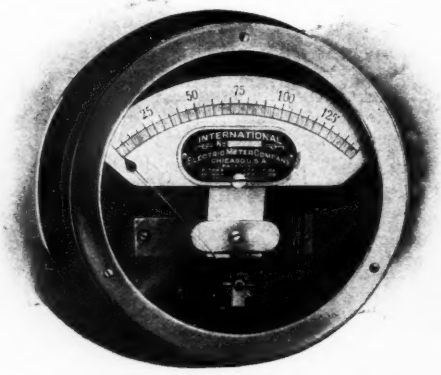


FIG. 4.—SCHOOL LABORATORY GLASS-FRONT INSTRUMENT.

FIG. 5.—DIRECT-CURRENT, PORTABLE VOLT-AMMETER.

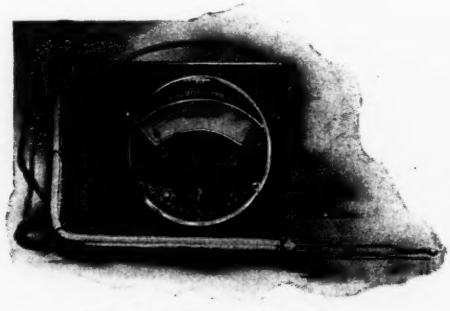


FIG. 6.—ELECTRIC PYROMETER.

Two distinct principles are now used. One exclusively for alternating current, which is an induction meter, known as the "repulsion" type, and one exclusively for direct current, of the Deprez-D'Arsonval or permanent-magnet type.

The "repulsion," or alternating-current, type is in fact a small transformer, with two secondary coils short-circuited; one being free to move. This instrument has a closed magnetic circuit of laminated iron and the torque is produced by the direct repulsion of the current in the primary upon the secondary; their currents being nearly in opposite phase. The moving element is extremely light and rigid, and is quick to respond to slight changes in current strength. The oscillation of the moving parts is magnetically dampened and swings in the best grade of sapphire bearings. Fig. 1 represents the alternating-current movement ready for mounting in the case. Fig. 2 represents the complete instrument.

The principle of the direct-current movement is well known and used by most of the manufacturers of high-grade instruments. The mechanical features, however, vary considerably. The International direct-current instrument is well balanced upon its support in the case, and parts may be readily removed for repairs. Fig. 3 represents the direct-current movement ready to mount in case. Fig. 4 represents the school laboratory glass-front instrument.

Fig. 5 represents a direct-current portable volt-ammeter, and Fig. 6 represents an electric pyrometer.

The shop and laboratory equipments are complete with special machinery and testing instruments necessary for the manufacture of high-grade apparatus.

The men employed for manufacturing, assembling, testing and inspecting the

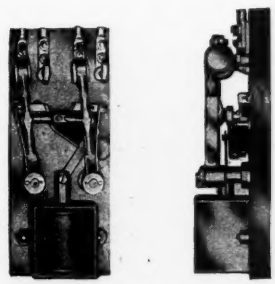
International instruments have had long experience in the work for which they have been selected.

The sales of this company are made direct to the user or through the jobber, whichever is more convenient for the customer. The electrical jobbers have been quick to learn that the International line of instruments is one especially desirable for them to handle. Shipments are made promptly and treatment secured from the International company is courteous and fair. The men in charge of the International Electric Meter Company's affairs are William W. Cheney, Jr., president; August Benson, secretary; Julian S. Jackson, sales manager, and John M. Lea, chief engineer.

Darrin Magnet Switches.

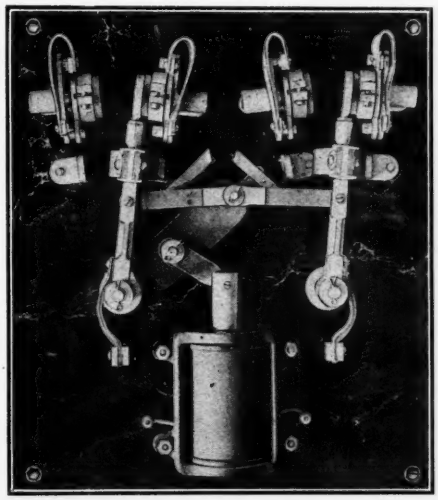
The Automatic Switch Company, 131 Liberty street, New York city, has developed a magnet switch which is of considerable interest to contractors. This is a small two-pole Darrin magnet switch with a capacity of twenty-five amperes. The Darrin magnet switch fills the requirement of a switch which will work equally well on direct or alternating current, in which the magnet circuit carries current only for an instant during the actual operation of the switch. The switch can be placed with carbon and copper butt contacts for motor control, or with knife-blade contacts for lighting work.

One of the illustrations shows the type DMS "300-2 R" reversing switch, and the other illustrations show the type DMS "25-2," front and side views. The reversing type switch has a capacity of 300 amperes.



FRONT AND SIDE VIEWS OF DARRIN TYPE DMS 25-2 REVERSING SWITCH.

By the peculiar construction of the magnet circuit in these switches the switch can be actuated either on or off or from one position to the other without carrying current in the magnet circuit longer than necessary to throw the switch. As the magnet circuit is opened on contacts on the switch itself, there will be no arcing at the controlling point. This type of switch can thus be controlled by thermostats, pressure regulators or with ordinary push-buttons, which have no quick-break features.



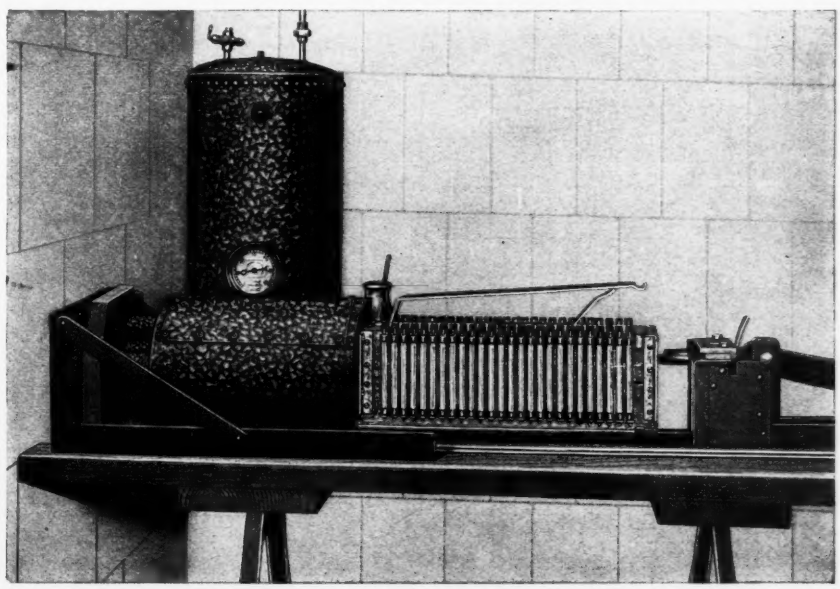
DARRIN TYPE DMS 300-2 R REVERSING SWITCH.

The switch is especially well adapted to the control of heavy lighting circuits from various remote points, and will be supplied, when so ordered, with magnetic blowouts at a slight additional expense.

All switches of seventy-five amperes or greater capacity continuous rating are provided with flexible carbon contacts so as to insure a level surface on closing. In the smaller sizes the contact arms are provided with springs to effect the same result.

Moisture-Proof Pole Cable Terminals and Junction Boxes.

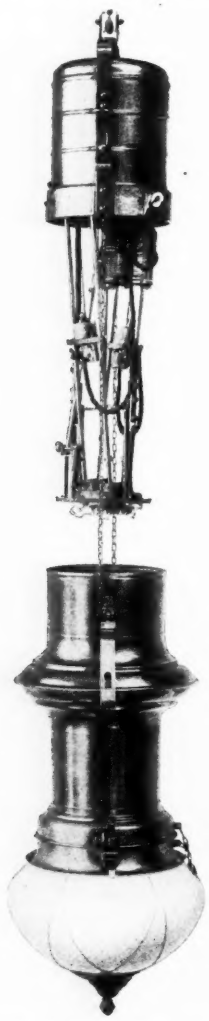
The accompanying illustration shows an interesting corner of the factory of Frank B. Cook, Chicago, Ill., where junction boxes and non-pothead terminals are tested for leakage. Special care is exercised in the construction and assembling of these types, and every precaution is taken to render them air-tight. The final inspection consists of testing each piece of apparatus under ten pounds air pressure, this being accomplished by connecting the piece to be tested with the machine shown in the illustration. The terminal or junction box is placed on a special frame, the air pipe being placed in the self-soldering nozzle with which these types of apparatus are equipped, and this nozzle is forced against a piece of solid rubber through which the air pipe extends. When the pressure is turned on the gauge registers any decrease of pressure in the tank, thus detecting any leakage. A further test is to cover the joints with soapy water, the slightest leak causing a bubble to form at the point. These types of Cook apparatus are guaranteed to be moisture-proof.



TESTING COOK WATERPROOF TERMINAL HEAD.

The Stave Flaming Arc Lamp.

The Stave flaming arc lamp, an illustration of which is shown herewith, has been built very carefully, taking advantage of a very valuable experience in the operation for many years of alternating-current arc lamps, and embodying many features of more than ordinary merit. The control of the lamp electrodes is attained by rotating aluminum discs in either direction, accordingly as either a series or a shunt magnet is excited. This control is ideal, three full revolutions of a disc corresponding to a feed of one-sixteenth inch.



STAVE FLAMING ARC LAMP.

The upper part of the lamp containing the regulating mechanism is sealed, and it is stated that in many years of operation it has not been necessary to break this seal to effect repairs. Each lamp is equipped with an internal resistance, so that it is immediately ready, burning two in series, for use on 115-volt circuits. Each lamp automatically takes care of its own voltage, and all will burn at forty-five volts.

All interior connections are made with fine stranded copper conductors, insulated with glass beads, which are impervious to fumes or heat, and all current-carrying parts are insulated by mica and air.

In the construction of the electrode holders, a substantial and easily accessible thumb-nut is used.

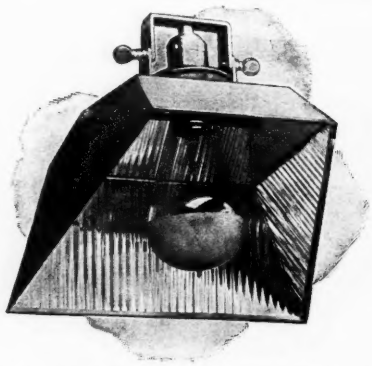
The lamp is furnished in several finishes, the brass, copper and nickel finishes being especially adaptable for the lighting of stores, halls, etc.

Theodore Stave, president of the Stave Electrical Company, manufacturer of this lamp, has been very successful in popularizing it, some 10,000 being in use in Europe, and is now making his headquarters at No. 1 Madison avenue, New York city.

Wheeler Reflector Company's New Fixtures.

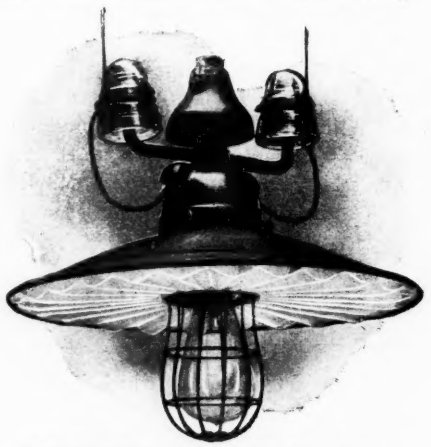
The Wheeler Reflector Company, 156 Pearl street, Boston, Mass., has placed on the market two new fixtures adapted especially for use with tungsten lamps.

The Wheeler tungsten adjustable window reflector No. 65 is a corrugated mirror-lined reflector attached to the stem of a fixture above the socket by a hinged holder which permits adjustment at any angle, the lamp remaining in a vertical position. With a 100-watt tungsten lamp this fixture distributes ample light over the average show window. The upward radiated light is all reflected down, that from three sides forward and down and that from the remaining side is radiated horizontally without interference.



WHEELER TUNGSTEN AJUSTABLE WINDOW REFLECTOR.

The Wheeler tungsten street fixture No. 770 consists of an eighteen-inch porcelain-enameled steel reflector fluted to give the most effective candle-power distribution and protected by a copper or painted steel hood attached to a cast holder. The illustration shows malleable iron cross-arms supporting pony glass insulators in a vertical position, but where desired these may be cast in one piece with the holders, so that the insulators may be held at right angles to the stem. The mica insulating joint is designed for high-tension circuits and will stand a break-down test of 34,000 volts. The important feature of this fixture is the reflector which, besides being fluted and slightly convex, is adjusted at such an angle with relation to the filament and of a sufficient diameter to intercept the light rays radiated in the direction of the base, that with a forty-candle-power lamp the light distributed shows a curve beginning at about forty-five candle-power at the horizontal, increasing to fifty candle-power at nearly every angle from twenty degrees to forty degrees below the horizontal, then gradually dropping to forty candle-power at sixty degrees and twenty-five candle-power in the direction of the tip.



WHEELER TUNGSTEN STREET FIXTURE.

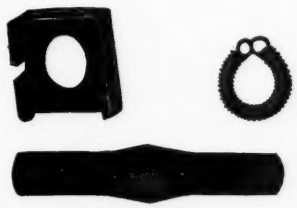
"Verus" Conduit.

Arthur P. Pierson, 23 North Juniper street, Philadelphia, Pa., is introducing a new non-metallic, flexible conduit, which is designated as "Verus." This conduit is made of narrow tubular sections of asbestos fibre treated with moisture-proof insulating compounds which have the properties of withstanding a fire test of about 400 degrees centigrade. The conduit is protected on the outside with an additional tubing, and the whole has a woven cover over all, treated with standard insulating compounds approved by the National Board of Fire Underwriters. This conduit not only has a fireproof interior, but a fireproof exterior as well.

These conduits are being manufactured by the Protecus Electric Manufacturing Company, of Allegheny City, Pa., for which Mr. Pierson is general sales agent.

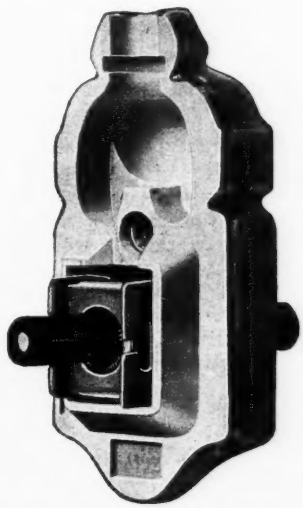
Cutler-Hammer Push-Button Specialties.

One of the most interesting, and doubtless a device which will be conceded revolutionary in its nature, is the push-button specialty which the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has placed on the market. This line includes porcelain pendent switches, porcelain surface switches, together with sub-bases, and porcelain push-button lamp sockets. The accompanying illustrations show the component parts of the mechanism of these switches and also show some of the present applications. The illustrations, however, indicate only in a fashion the high degree of ingenuity which this device represents. The switch consists essentially of three parts, a push bar extending clear through the switch, a coiled steel spring and a moving contact-piece. These three elements may be assembled in any form of containing receptacle to perform any switch function which may be required.

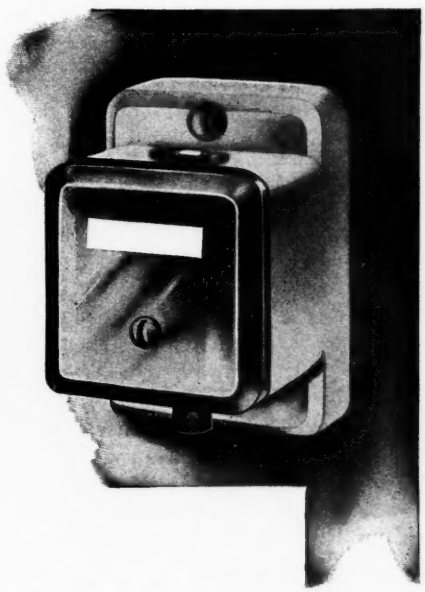


COMPONENT PARTS OF SWITCH.—A MOVING CONTACT-PIECE, A COILED STEEL SPRING AND A PUSH BAR.

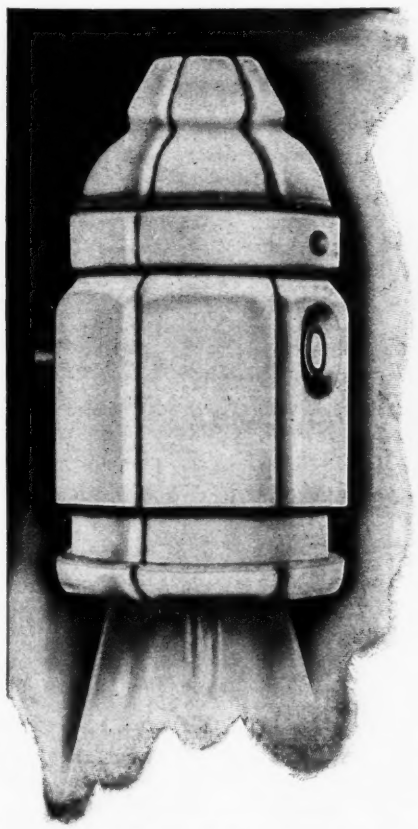
The principle embodied in the switch mechanism is that of a coiled spring contracting on a tapering surface, the action being similar to that of a rubber ring slipped over the knob of an umbrella or a coiled-wire sleeve supporter which, when passed over the elbow, will travel a short distance up or down the arm of itself.



SECTIONAL VIEW OF SMALL PORCELAIN PENDENT.



PORCELAIN SURFACE SWITCH FOR CONCEALED WORK.

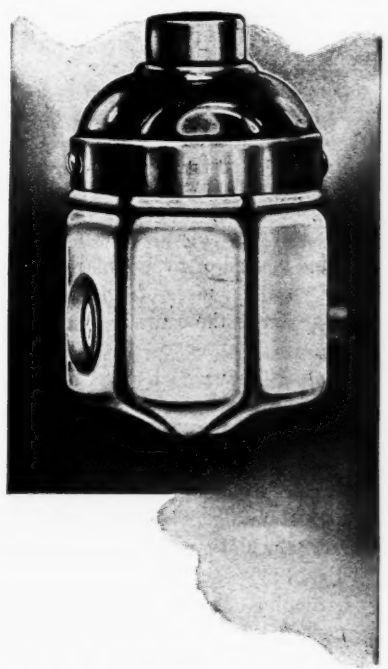


PORCELAIN PENDENT PUSH BUTTON LAMP SOCKET.

The action is snappy and positive in either direction. The mechanism gives a quick "make" as well as a quick "break," the movement of the contact-piece is the same whether the push-bar is moved fast or slow. The contact-piece can not be moved part way and let slip back again drawing an arc.

This new line of Cutler-Hammer push-button specialties is made of porcelain, which is non-corrosive and non-conductive. They will not tarnish and the user can not receive a shock, because all of the metal parts are encased in porcelain. Any slight arcing which might possibly occur is confined to a porcelain chamber away from the circuit wires and terminals. Liberal space is provided for knotting the flexible cord and the removal of a single screw gives access to the interior of the switch, making the wiring of these devices an easy matter. A removable fibre bushing is furnished with each of the pendent switches and the lamp socket, reducing the size of the outlet to the diameter of standard cord. When reinforced cord is used this bushing is removed.

The fire glaze on the porcelain is practically indestructible and the choice of colors is such that a shade can be selected that will harmonize with the surrounding trim. The standard glazes are plain white, ivory tint, wood brown and neutral gray. Special glazes can be furnished to order.



BRASS CAP PORCELAIN PENDENT SWITCH.

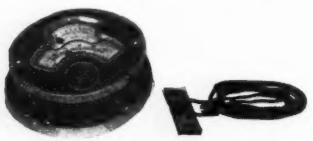
These devices have been approved by the Underwriters' Laboratories at Chicago.

A New Automobile Instrument.

The General Electric Company has lately placed on the market a new automobile instrument for use on electric vehicles. This instrument, known as the type DK, consists of a combination ammeter and voltmeter enclosed in a dust and moisture-proof aluminum case and is especially designed to withstand without injury the constant vibration and exposure incident to this class of service.

Both elements are constructed on the D'Arsonval principle. In the ammeter element a coil of wire carrying the current to be measured, or a shunted portion of it, is wound on a light aluminum frame, so pivoted in jeweled bearings as to move freely in a small annular space between a soft iron core and the pole-pieces of a permanent magnet. This element is identical with that of the type D switchboard instrument, with the exception of the permanent magnet, which is made somewhat larger in order that the voltmeter may be placed within the space enclosed by it.

The voltmeter has smaller parts throughout and differs slightly in con-



COMBINATION VOLT-AMMETER FOR AUTOMOBILE SERVICE.

struction. It has a circular form of armature frame instead of rectangular, and the core is a spherical piece of soft iron. Its general action is the same as that of the ammeter.

It is a well-known fact that when magnets are subjected to constant vibration their efficiency is impaired and this must be taken into account in the design of automobile instruments. The magnets used in DK automobile instruments are made from the best quality of magnet steel obtainable, the special processes of ageing and hardening further insuring their permanency.

Another important advantage of DK instruments is the fact that they are strictly dead-beat, the pointer quickly coming to rest after each change in current or voltage. The scale divisions are very uniform and legible; this, together with the fact that the two scales are placed one above the other in close proximity, permits accurate simultaneous reading of volts and amperes. When desired, a suitable bracket carrying a miniature lamp with shade will be furnished for illuminating the dials.

The standard voltmeter scales are 120 and eighty volts. Either of two ammeter scales is standard, *viz.*, 150-0-150 or 70-0-150, the scales showing both charging and discharging current. Any other capacities of voltmeter or ammeter can be furnished when desired. It often becomes necessary to measure the voltage across individual cells and for this purpose a second voltmeter scale reading from 0 to 3 volts can be furnished on request.

The severe vibrations to which automobile instruments on commercial vehicles are subjected prevent the indications being read. To overcome this difficulty the General Electric Company has designed an "anti-vibration support," upon which the type DK instrument may be mounted. This is a new idea in automobile instrument construction and makes possible the use of indicating instruments on commercial vehicles. The black japan finish and the polished aluminum trimmings contribute to the neat appearance of the DK instrument.

A Powerful Gasolene Blow Torch.

The "Imp" torch, manufactured by the Frank Mossberg Company, of Attleboro, Mass., is a patented device which it is claimed will do as much work as most of the larger torches on the market, with the advantages of compactness, simplicity and cheapness. It is entirely automatic in operation, has no pump nor valve, needs

THE "IMP" GASOLENE BLOW TORCH.

no tools, starts with a match, and gives a perfectly clean, powerful Bunsen flame for over two hours on four ounces of gasolene.

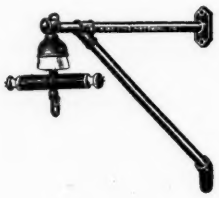
The corrugated neck increases the heating surface to such an extent that the flame of a match easily generates gas enough for starting, after which the carefully designed mixing tube renders further attention unnecessary.

The "Imp" will be found valuable by electricians, automobilists, the handy man, and, in fact, any one who wants intense, clean heat, cheaply and quickly.

New Ajax Specialties.

The Ajax Line Material Company, Chicago, Ill., has added to its line of devices for contractors' use the three illustrated herewith. One is an insulated hook, designed as a low-priced insulator

AJAX INSULATED HOOK.



AJAX "MITRE" BRACKET.

for use with flaming and other arc lamps. Another is a modification of the regular Ajax toggle bolt having a detachable and ornamental head. This type was designed for plumbers' use, but is proving popular also for certain classes of electrical work. The third is a short arc lamp bracket for pole or wall use, with an insulating cross

AJAX PLUMBER'S TOGGLE.

arm for guiding the wires and insulating the lamp. It is one of a series of easily erected fixtures designed to replace the crude riggings heretofore used.

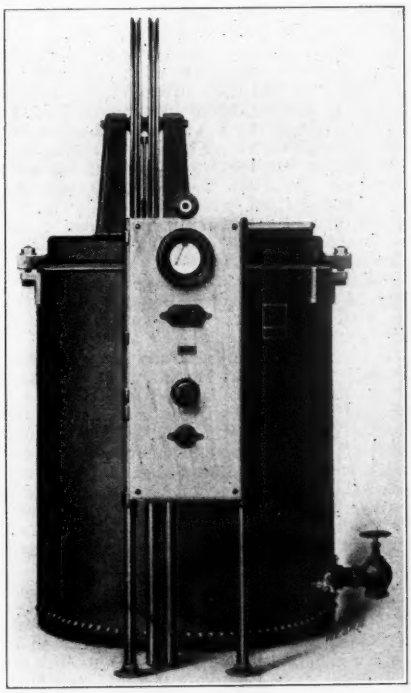
The "Success" Chemical Fire Extinguisher.

The H. W. Johns-Manville Company, 100 William street, New York city, has recently put on the market the "Success" portable fire extinguisher. This extinguisher is made of extra-heavy Lake Superior cold-rolled copper securely riveted and reinforced by heavy shoulders tested to withstand a pressure of 350 pounds per square inch. The method of attaching the dome to the body of the shell is said to make that joint the strongest part of the extinguisher. The large wheel at the top of the machine is a convenience in opening and closing it, at the same time serving as a base on which to rest the extinguisher when reversed. The framework or bottle holder containing the supply of sulphuric acid is cast brass and virtually indestructible. The bottle, of standard size and type, for holding the acid, is obtainable anywhere in case of accidental fracture from any cause. The hose, tested to 400 pounds per square inch, is only detachable with a wrench, being joined to the body by a swivel ground joint. This extinguisher is included in the list of approved chemical extinguishers issued by the National Board of Fire Underwriters.

Westinghouse Mercury Rectifier Arc-Lighting System.

In order to secure the advantages of direct-current series arc lamps and the alternating-current system of distribution and regulation, the Westinghouse Company has recently introduced a new system of arc lighting in which the most desirable points of both systems are combined. The alternating-current supply is changed to a direct-current by means of a Cooper Hewitt mercury rectifier, and this rectified current is then available for operating direct-current series arc lamps.

This system is applicable to all types of direct-current series carbon arc lamps, and also to the Westinghouse metallic flame



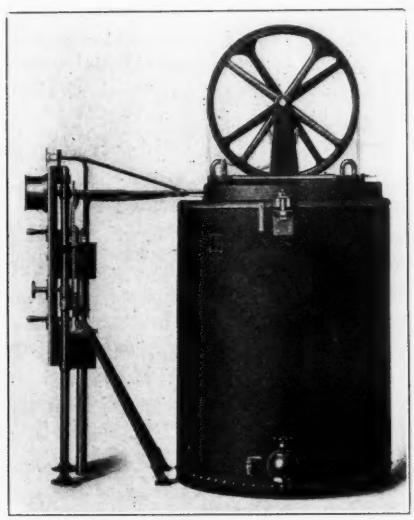
FRONT VIEW OF SEVENTY-FIVE-LIGHT MERCURY RECTIFIER, CONSTANT-CURRENT REGULATING TRANSFORMER OUTFIT.

arc lamp for which it is specially adapted. This lamp is a new development whose efficiency as a light producer is nearly double that of the carbon arc lamp. It is essentially a direct-current lamp, and as it requires a current of but four amperes, the existing arc generators as originally designed are not suitable for supplying current for it. These lamps, however, are extremely economical to operate because of their very high efficiency.

The combination of alternating-current regulating transformers and mercury rectifiers with any type of direct-current series lamps comprises a lighting system that is both simple and reliable, and that has proved highly successful in its practical applications. Its operation is devoid of any complications, and its notable economy makes its use extremely desirable.

The rectifier outfit consists of a constant-current regulating transformer, a mercury rectifier bulb, and a panel containing the necessary switches, instruments, etc. The regulating transformer and the rectifier bulb are mounted in the same tank, and by means of such outfits power may be drawn from an alternating-current circuit of either twenty-five or sixty cycles and delivered as direct current to the series arc lamp circuits. The rectifier bulb requires no manipulation except to start it, after which it operates without further attention.

The constant-current regulating transformer used with the rectifier set is of the repulsion coil type and is oil-cooled and oil-insulated. It is so arranged as to give a constant secondary current and to insu-



SIDE VIEW OF SEVENTY-FIVE-LIGHT MERCURY RECTIFIER, CONSTANT-CURRENT REGULATING TRANSFORMER OUTFIT.

late the arc lines from the primary circuit.

The rectifier bulb consists of a pear-shaped closed glass vessel about seven inches in diameter at its largest part. It is provided with four electrodes, the two upper ones being of graphite and the two lower ones of mercury. The bulb is exhausted to a high vacuum. Metal terminal thimbles are provided to which connections are readily made by spring clips or connectors.

The rectifier panels are made in four capacities, for twenty-five, thirty-five, fifty and seventy-five-lamp circuits, and are built of blue Vermont marble, supported upon a gas-pipe frame, which is braced to the floor. The three smaller-capacity panels are essentially similar and contain an ammeter, two oil switches, fuse blocks and fuses, a tilting handle and a pilot lamp in series with the arc circuit.

The ammeter is located at the top of the board and is connected in the direct-current lamp circuit. It is specially insulated so as to avoid all danger to attendants from grounding of its case.

The oil switch controlling the primary is double-pole. This may be double-throw when required. Suitable fuses are inserted in the primary leads to provide for short-circuit and overload protection. A double-pole oil switch also controls the secondary or direct-current series lamp circuit.

The seventy-five-light panels contain the same apparatus as the smaller-capacity panels, just described, except that the oil switch controlling the secondary is of a different type. In the seventy-five-lamp outfits the two bulbs are mounted so that both are tilted together. The secondary oil switch has two handles, one of which operates a double-pole switch in the lamp circuit and the other a single-pole switch which short-circuits one of the rectifier bulbs. For circuits of 6,600 volts and higher the fuse blocks are separately mounted.

The Dielectric Company of America.

The Dielectric Company of America, with factories and headquarters at Belleville, N. J., reports that its sales are showing considerable improvement and that the outlook for future business is very encouraging.

This company, although but recently organized, is meeting with marked success in its weatherproof-wire department, while its underground system is becoming more extensively used than ever. It is manufacturing the well-known DE brand of weatherproof wire which is exciting interest among the lighting plants and also among the signal engineers.

The Dielectric system of underground construction is designed to meet the demand for an underground system either for high or low potential, which is not as expensive as the present duct systems. Besides the advantage of first cost, the company claims that its system is also cheaper to maintain in that after the wires are once laid there is nothing to replace or repair. Besides these two very important lines, this company is also preparing to put on the market its HVH special wire, which is designed to be used in especially difficult places where a wire is required to not only carry a high voltage but to withstand the action of the elements and the action of acids, gas, etc.

New Receiver for New York City Railway.

By continuing Adrian H. Joline and Douglas Robinson as Federal receivers for the Metropolitan Street Railway Company and appointing William W. Ladd as receiver for the New York City Railway Company in their stead, Judge Lacombe of the United States Circuit Court on July 16 carried out his decision that the companies should have separate receivers. Mr. Ladd will take up his duties August 1. The court directs Joline and Robinson to file with the court, not subsequent to August 1, a statement of receipts and expenditures of the dual receivership to July 1. It was on a motion made by Bronson Winthrop, representing the Morton Trust Company, that the Metropolitan receivership was separated from the New York City Railway receivership. In that motion the Guaranty Trust Company joined. The separation is made for the purpose of expediting foreclosure proceedings. Mr. Ladd was appointed on motion of Benjamin S. Catchings, who represented the tort creditors' committee of the New York City Railway Company. Mr. Ladd's bond was fixed at $50,000.

Judge Lacombe said that when the same receivers were appointed for the Metropolitan and the New York City Railway the lease of the Metropolitan system to the New York City Railway still was in force and no suit to foreclose mortgage had been instituted. Since then the situation has changed, he said. A regular foreclosure suit against the Metropolitan for unpaid interest under refunding mortgage has been instituted and the court said it was fitting that the property covered by that mortgage should be taken over by receivers under that suit who would operate the Metropolitan system alone. Judge Lacombe said that the clause in the lease deferring re-entry for non-payment of rent until one year after default presented no difficulties. There was not merely a simple default, he asserts. Because of the inability of the receivers to pay from the income the mortgage interest due January 1, 1908, on the Third Avenue mortgages that line had been foreclosed upon, and an independent receiver appointed, who has taken it into possession, thus disrupting and destroying the original system covered by the lease.

It was ruled by the court that the present bonds of Joline and Robinson might be extended to cover their future operations. The court included in its opinion assurances that the receivers for the Metropolitan would adopt and affirm all contracts which related to the operation of the system which were adopted or entered into by receivers for the New York City Railway. Judge Lacombe said the court reserved the right to impose a lien upon the property itself for any obligations incurred by the court in its operation of the railways and also for the expense of the court proceedings.

Mr. Ladd, the new receiver for the New York City Railway, formerly was deputy city chamberlain, resigning that office to resume the practice of law. He was a member of the board which prepared the Military Code adopted by the Legislature in 1898. He served four years as assistant corporation counsel. He is now a practicing lawyer in No. 20 Nassau street.

International College Comity—A Unique Ceremony.

University and college degrees are occasionally, in exceptional cases, conferred *in absentia*. It has remained for Lehigh University, acting in conjunction with the University of Liverpool, England, to signalize a new and most interesting departure in the practice, replete with kindly expressions of international comity and friendship on the part of the University of Liverpool.

In June last Lehigh University awarded to Horace Field Parshall, of London, England, the honorary degree of Master of Science, this being the fourth honorary degree ever granted by Lehigh. Mr. Parshall is an American who has built up in England a practice as a leading electrical engineer. He is well known as an author; his joint work with H. M. Hobart on "Electric Railway Engineering" is an engineering classic. Mr. Parshall is a graduate of the course in electrical engineering of Lehigh University of the year 1887. For some ten years after his graduation his work was in this country, during which time he held in 1894, in the Massachusetts Institute of Technology, a lectureship on the designing of electrical machinery. Since 1897 he has been resident in London and has been engaged largely in the introduction of electric traction into Great Britain, and is now engaged as expert on the hearings before a parliamentary commission on the London and District Electricity Supply Bill. This engagement prevented Mr. Parshall coming over here in June to receive the degree at Lehigh's commencement exercises, and resulted in the arrangement by which the University of Liverpool graciously undertook the duty of conferring the degree on behalf of Lehigh University.

Vice-Chancellor Dale, of the University of Liverpool, in writing President Drinker the acceptance by the University of Liverpool of the duty of conferring the degree, gives the following kindly expressions of cousinly goodwill:

The council and senate of this university have agreed to act on the suggestions that you make, and to confer formally on Mr. Parshall the honorary degree that has been awarded to him by the university over which you preside. When the hood and diploma have reached us I will then arrange with Mr. Parshall for his formal admission to the degree.

So far as I am aware, no precedent or parallel for such an act can be found in the history of British universities. But it is our business to make precedents as well as to follow them, and we trust that in so doing our act will be regarded as an expression of fellowship and sympathy with kindred institutions carrying on similar work, established for similar services, and bound to us by many ties.

The letter of attorney from Lehigh to Liverpool was couched as follows:

WHEREAS, Horace Field Parshall, in the year eighteen hundred and eighty-seven, completed at Lehigh University the special course in electrical engineering then given by the university, and since that time has risen to high eminence in his profession, and has distinguished himself and has reflected honor on his Alma Mater by his scientific work and publications, and the university is desirous of recognizing his achievements in this regard, and of doing honor to one who has so honored himself; and,

WHEREAS, The said Lehigh University has decided to confer upon the said Horace Field Parshall the honorary degree of Master of Science; and,

WHEREAS, The said Horace Field Parshall is engaged in Great Britain in the pursuit of work of such importance as to make it impracticable for him to attend at the university at South Bethlehem, Pa., at the university's commencement exercises on June tenth, nineteen hundred and eight, to receive said degree, and the authorities of the University of Liverpool have graciously offered to act as the representatives of Lehigh University in the act of conferring said degree;

***Now Know All Men by These Presents*, That the Lehigh University, an educational corporation existing under the laws of the state of Pennsylvania, in the United States of America, hereby nominates and appoints the chancellor of the University of Liverpool or such person as he may designate to confer for and on behalf of the Lehigh University and by its authority, and as its attorney and representative, upon the said Horace Field Parshall, the degree of Master of Science, and in testimony thereof to deliver to the said Horace Field Parshall the diploma of the Lehigh University evidencing said degree.**

Witness the seal of the said the Lehigh University this day , A. D., nineteen hundred and eight.

HENRY S. DRINKER,
President of Lehigh University.

W. A. LATHROP,
President of the Board of Trustees.

Seal of Lehigh University.

Attest:
E. P. WILBUR.
Secretary of the Board of Trustees.

At the ceremony of July 2 Mr. Parshall was presented by the dean of the faculty of science of Liverpool University for admission to the degree and the vice-chancellor conferred the degree and delivered to him the diploma of the Lehigh University conferring the degree.

Current Electrical News

DOMESTIC AND EXPORT.

MISSOURI ELECTRIC RAILWAY DEAL—A despatch from St. Louis states that the United Railways Company and the North American Company have incorporated a subsidiary company known as the Missouri Electric Railway Company, into which will be consolidated all the electric lines in St. Louis County. The capital is $1,000,000. The incorporators are acting for the United Railways management and the North American Company interests, which control that company.

GREAT WESTERN POWER COMPANY TO BUILD PLANT AT EAST OAKLAND—The Great Western Power Company has started the erection of what will be one of the greatest power plants on the coast. The site for the new power-house is at the end of Fourth avenue in East Oakland. The new plant will cover several thousand square feet of ground on the west side of Fourth avenue, and according to the plans of the company, will be one of the most completely equipped in the state.

A MILLION DOLLARS FOR IMPROVEMENTS—The Coney Island & Brooklyn Railroad is installing a number of improvements that Superintendent D. W. Sullivan says will cost considerably more than $1,000,000. One of the principal of these, the burying of overhead feed wires, is now practically completed. A conduit has been laid along the entire system from Coney Island, and the cables installed under the immediate supervision of Mr. Murphy, the electrician of the road. These are now in operation, and it is through them the power is now being supplied to operate the cars on the Smith street, DeKalb and Franklin avenue lines. The overhead wires have already been removed between the depot at Smith and Ninth streets and the Park Circle, and the remainder will come down in short order. The most striking improvement, however, is the new building that is being erected for the power plant at Smith and Ninth streets. There will be generated the entire power to run the lines of the road.

SYNDICATE SEEKING TO CONTROL MONTREAL LIGHT, HEAT AND POWER COMPANY—An American syndicate with $40,000,000 capital, headed by Leslie M. Shaw, formerly Secretary of the Treasury, is said to be negotiating for control of the Montreal Power Company, with the intention of subsequently gaining control of a number of other Canadian public service corporations, including the Montreal Street Railway and some Toronto franchises. The syndicate is known as the Canadian Public Service Corporation. It proposes to guarantee six per cent for the first year, seven per cent for the second and eight per cent thereafter on the stock of the Montreal Power Company in return for an option to purchase the stock during the first year at 110, during the second year at 112½, and so on at an annually increasing price of 2½ points up to 135. As a guarantee of the dividend the corporation proposes to deposit $8,000,000 with a Montreal trust company, in the event of its acquiring controlling interest.

ONONDAGA INDEPENDENT TELEPHONE COMPANY—At the first meeting of the directors of the Onondaga Independent Telephone Company, held in Rochester last week, Alexander H. Cowie, of Syracuse, was elected president; John B. Pierce, manager of the old Independent Telephone Company of Syracuse, was elected general manager and assistant treasurer of the new company. George R. Fuller, of Rochester, N. Y., was chosen vice-president and W. Roy McCanne secretary and treasurer. The other directors are Hendrick S. Holden, of Syracuse, and Joseph W. Taylor and Edward W. Peck, of Rochester. The Onondaga Independent Telephone Company took possession of the properties of the Independent Telephone Company of Syracuse on July 13. All the property of the old company, including the exchange in that city and lines to various towns and cities in central New York, was bid in on behalf of the reorganization committee at the mortgage foreclosure sale July 3. Under the plans of reorganization the title is now turned over to the Onondaga company.

ELECTRIC RAILWAYS.

FITCHBURG, MASS.—The Fitchburg & Leominster Street Railway Company has petitioned the Railroad Commission for approval of an issue of 2,500 additional shares of stock to be offered stockholders at $100 per share.

HAMMONDSPORT, N. Y.—The Appellate Division of the Supreme Court has annulled the decision of the former State Railroad Commission to grant to the Bath, Branchport & Hornell Electric Railroad a certificate of public convenience and necessity. The annulment is made on the ground that contrary to law one-tenth of the minimum amount of capital stock of the company had not been subscribed and paid.

EVANSVILLE, IND.—The annual election of the Evansville Railway Company, operating the Evansville and Mt. Vernon and the Evansville and Rockport traction lines, held in this city on July 6, resulted as follows: President, W. L. Sonntag, Evansville; vice-president, W. I. Rudd, Rockport; secretary, Fred W. Reitz; treasurer, Marcus S. Sonntag; directors, W. H. McCurdy, chairman; John M. Funke, Fred W. Reitz, C. H. Batten, Philip Speck, M. S. Sonntag, Wm. M. Ford, Chris Kanzler, W. L. Sonntag, A. F. Karges and W. I. Rudd.

OREGON, MO.—The contract for building the Oregon Interurban Railway has been awarded to W. M. Wogan, of Leavenworth, Kan., for $40,000, this amount to make the road ready for the rolling stock—building bridges, culverts and fills, and laying the ties and steel, including sidetracks and putting in all other necessary fixtures aside from the engines and cars. The road is to be completed and ready for the rolling stock by October 1 next. The Oregon Interurban Railway is to be built from the Burlington yards at Forest City to a point four and a half miles distant, at the northern edge of the city of Oregon. It will be of standard gauge, and capacity for all sizes of rolling stock used upon the main line of the Kansas City, St. Joseph & Council Bluffs Railway. Thirty-seven bids for the contract were filed with the company.

HARRISBURG, PA.—Governor Stuart has approved the merger of eight trolley lines in western Pennsylvania under the name of the Suburban Railway Company, with a capital of $150,000 and offices at Rochester. The companies consolidated are the original Suburban Company, the Freedom & Baden Electric Street Railway Company, Sewickley & Leetsdale Electric Street Railway Company, Beaver & Bridgewater Electric Street Railway Company, Beaver Falls Electric Street Railway Company, Rochester, Beaver & Vanport Electric Street Railway Company, New Brighton, Beaver Falls & Marado Electric Street Railway Company and Economy and Harmony Electric Street Railway Company. The new company will have these officers: W. A. Park, Rochester, president; Samuel Morgan, Freedom; J. H. Park, P. A. Smith and Charles Connel, New Brighton.

CLEVELAND, OHIO—The Municipal Traction Company, which is operating all the street car lines in Cleveland under the plan carried out by Mayor Johnson, reports a deficit of $34,916 for the month of May. Mayor Johnson says this deficit is largely due to the strike of the street railroad men. Taking that into consideration, he says the statement is satisfactory. The company must pay operating expenses and six per cent dividend on the stock or forfeit its right to operate the lines. The lines have been operated at three cent fare a little over two months, but one cent is charged for each transfer. Judge Phillips, in Common Pleas Court, has granted a mandatory order compelling the Municipal Traction Company to give good service and the same rate of fare to the town of East Cleveland, a suburb, as is enjoyed by the city of Cleveland. The court held this was compulsory under the original franchise granted to the street-car company by the suburban town. The Municipal Company, when it recently took over the street-car system, announced that three-cent fares would prevail only within the city limits and that the fare to and from the suburban towns would be five cents.

TELEPHONE AND TELEGRAPH.

DOVER, N. H.—The New England Telephone and Telegraph Company will construct a telephone line from Dover to Eliot.

CONESTOGA, PA.—The Conestoga Telephone Company is making a number of improvements to its exchange at Birdsboro, including the rebuilding of the switchboard.

OMAHA, NEB.—The Independent Telephone Company is preparing to start work on its building in South Omaha. This will have a capacity of 5,000 telephones and is expected to be in operation by November 1.

HARTFORD, WIS.—The special election held recently for the purpose of voting on the proposition to install a municipal electric light plant resulted favorably to the plan. A plant to cost $27,000 will be installed, to do commercial as well as street lighting.

MARSHALLTOWN, IOWA—The Marshall Telephone Company, which was recently amalgamated with the Bell system, locally, has purchased a centrally located business building, and will spend $10,000 in improving and building an addition forty by fifty-one feet.

FLORENCE, UTAH—John B. Morris, of Erie, Pa., and Robert E. Archibald, of Cleveland and San Francisco, representing a syndicate of Brooklyn and Philadelphia capitalists, have announced that they will build an electrical power plant and a custom mill in this district.

WHEELING, W. VA.—Dr. John L. Dickey and Samuel W. Harper have been elected directors of the National Telephone Company. The board organized with the Hon. John A. Howard as president; S. W. Harper, treasurer and vice-president, and William C. Handlan as secretary and manager.

PROVIDENCE, R. I.—It is announced that it is the intention of the Narragansett Electric Lighting Company to install a 4,000-horse-power steam turbine within the next four months. The present capacity of the station is 15,000 horse-power, which is not now sufficient for the winter load.

CHICAGO, ILL.—A new telephone exchange designed to provide ultimately for 10,000 subscribers has been established by the Chicago Telephone Company in the downtown business district. The new office is called "Franklin" and has been opened to relieve congestion and take care of future growth in the "Main" district.

SYRACUSE, N. Y.—The plant of the Syracuse Independent Telephone Company has been sold in mortgage foreclosure proceedings. Roy McCanne, of Rochester, bid in the property in behalf of the reorganization committee of the United States Independent Telephone Company for $25,000, but this is subject to a mortgage for $1,250,000.

LINCOLN, NEB.—A fee of $5,003 was paid by the Independent Long-Distance Telephone Company of Omaha for filing articles of incorporation with the secretary of state. The company is organized with an authorized capital stock of $10,000,000. The incorporators are: T. C. Williams, of Farlin, Iowa; C. C. Ludy, Cooper, Iowa, and D. W. Study, Jefferson, Iowa.

NASHVILLE, TENN.—The Mine City Telephone Company, of Polk County, has been granted a charter. The company proposes to own, operate and construct a telephone line from Ducktown to Copper Hill and other places in Polk County. The capital stock is $500 and the incorporators are: J. M. Kilpatrick, Carl Center, C. M. Campbell, W. S. Love and W. I. Morris.

COLVILLE, WASH.—H. R. Williams, of Spokane, has purchased the entire stock of the Northwestern Light and Power Company, which operates the plant at Meyers Falls that supplies the towns of Kettle Falls, Meyers Falls, The Mission and Colville with light and power. The system was established five years ago, the company being promoted and controlled by T. A. Winter.

OLYPHANT, PA.—The light committee appointed by the Olyphant council to investigate the condition of the municipal lighting plant and report on the advisability of accepting the offer of the Scranton Electric Company to purchase the plant have decided it would be well to buy power from the local company, but voted to maintain the electric plant under municipal management.

KANSAS CITY, MO.—The telephone line of the American Telephone and Telegraph Company between Kansas City and Denver has been completed and put into operation. Heretofore the entire United States has been divided from a telephonic standpoint by a region in a line north and south with the western half of Kansas. The service inaugurated is the first telephone line to bridge the gap.

RICHMOND, IND.—A deal has been consummated between the Richmond Home Telephone Company and the Central Union Telephone Company, as a result of which the independents will gain entrance to Minneapolis and other large cities. This will effectually open up the Northwest to the independents, Richmond being one of the most important points in the independent system of the Mississippi Valley.

BILLINGS, MONT.—Following the purchase of the electric light plants of the Billings Water Power Company and Yegen Brothers by the Eastern Montana Power Company, the work of connecting the two systems has begun. The plants are located about one-half mile apart on the Yellowstone River. According to arrangements which the new company has in view a transmission line will extend throughout eastern Montana.

PEORIA, ILL.—The Farmers' Mutual Telephone Company, with a capital of $20,000, has organized by the election of the following officers: President, John Sommers, of Elm Grove; vice-president, John Strickfaden, Groveland; secretary-treasurer and manager, Arthur Becker, Tremont. Trustees, Samuel Kinsinger, Groveland; Theodore Schwarzentraub, Morton; A. L. Robison, Elm Grove; Henry Bollinger, Tremont; Robert Kennedy, Dillon; Joseph Augsburger, Hopedale.

MILWAUKEE, WIS.—It is announced that the American Telegraph and Telephone Company, which has been engaged in laying an underground telephone system between Milwaukee and Chicago, has completed the line between this city and Racine, and expects to have the line completed to Chicago in the fall. The underground system will be connected up with the telephone exchanges in the cities and villages between Chicago and Milwaukee. The Wisconsin Telephone Company is extending its lines to Rhinelander, Minocqua and other points in northern Wisconsin.

REXBURG, IDA.—At a meeting of the city council an ordinance was passed granting a franchise for the use of the streets and alleys of Rexburg to the Idaho Power and Transportation Company, Limited, for transmission and distribution of electric current. The headquarters of this company is at Idaho Falls. The rates are $7 per month for arc lights, ten cents per kilowatt-hour and a flat rate of seventy-five cents for first lamp, fifty cents for the second lamp and forty cents for the third lamp of sixteen candle-power. The service will be twenty-four hours per day.

NEW PUBLICATIONS.

STRENGTH OF CONCRETE BEAMS—The United States Geological Survey has issued a bulletin, No. 344, on the strength of concrete beams. It gives the results of testing of 108 beams, conducted at the Structural Materials Testing Laboratory. This report, which has been prepared by Richard L. Humphrey, describes the structure of the beams and method employed in testing them.

COLUMBIA UNIVERSITY BULLETIN OF INFORMATION—Columbia University, New York city, has published a bulletin of information concerning the Schools of Mines, Engineering and Chemistry. This takes up the departments of mining, metallurgy, civil engineering, electrical engineering, mechanical engineering, chemical engineering and chemistry for the 1908-1909 course.

THE INLAND EMPIRE SYSTEM—The publicity department of the Inland Empire System has prepared a number of very handsome illustrated bulletins devoted to the pleasure resorts and routes of the Spokane & Inland Empire Railroad Company, the Idaho & Washington Northern Railroad, and the Red Collar Steamship Line. There is a description of the Bozanta Tavern, at Hayden Lake, Ida.; the system of the Idaho & Washington Northern Railroad; excursions to the shadowy St. Joe River, Idaho, the Pend Oreille River route, through the pines to Spokane Lake resorts, and profitable farming in the Spokane country. Charles E. Flagg is the manager of publicity.

PERSONAL MENTION.

MR. E. R. KNOWLES, the well-known consulting engineer of New York city, is an active member of the Building Code Revision Commission of New York city, appointed by the board of aldermen.

MR. A. W. CLAPP, who had under preparation a volume entitled "Hydroelectric Plants of United States, Canada and Mexico," and who had gathered together a considerable amount of valuable data, has some mail for him at the office of the ELECTRICAL REVIEW. If he will send us his address this mail will be forwarded.

MR. F. N. DRESING, chief of the Chinese Imperial Telegraphs and special delegate representing the Chinese Minister of Communications to the Lisbon International Telegraph Conference, was a visitor to New York and Chicago last week, where he spent some time with various electrical interests. He will return to China, by way of San Francisco, the latter part of July.

MR. DAVID S. MURRAY, general manager of the Rocky Mountain Bell Telephone Company, was tendered a banquet at the Elks Club, Salt Lake City, and presented with a handsome gold watch and fob by his associates upon the occasion of his leaving the company. Mr. Murray severed his connection with the Rocky Mountain Bell Telephone Company a few weeks ago to accept an executive position with the Pacific States Company of San Francisco, and completed his service there a week ago. His career has extended from 1884, when he began as a collector and worked his way steadily upward until a few years ago, when he became general manager. During his administration the company has grown greatly, and there is a great deal of regret among the employés at his departure. From small beginnings the company has now extended its influence over four states and spread lines into practically every town and city of that territory.

MR. WILLIAM H. BROWNE has been appointed general manager of the Rockingham Power Company, which has in progress of construction at Rockingham, N. C., a 66,000-volt, three-phase, hydroelectric development of considerable magnitude. Mr. Browne is now on the ground actively superintending construction. Mr. Browne's connection with the electrical industry dates back to 1888 in the building of the electric railroad at Richmond, Va. Following this, he was associated with the Westinghouse interests in New York city and later was general manager of the United Electric Light and Power Company, of New York city. From 1894 to 1895 he was receiver of the Flushing & College Point Railway, Flushing, Long Island. From 1895 to 1902 he was general manager of the Royal Electric Company, Montreal, Canada. From 1902 to 1906 he was treasurer and general manager of the Stanley Instrument Company, Great Barrington, Mass.

NEW MANUFACTURING COMPANIES.

HOBOKEN, N. J.—The Gross Electric Company has been incorporated with a capital of $25,000 to act as mechanical engineer, electrician, etc. The incorporators are: H. Wilkens, C. B. Wilkens and S. Gross, of Hoboken.

COLUMBUS, OHIO—The Canton Telephone Seal and Lock Company, of Canton, has been incorporated with a capital of $10,000 by E. C. Hill, Edward Rowmel, J. L. McDonald, T. E. Phillippi, E. H. Forester and W. C. Wingwire.

NEW YORK, N. Y.—Edwards & Company, Incorporated, Bronx, has been incorporated to manufacture electric apparatus, machinery, etc., with a capital of $75,000. The incorporators are: R. Edwards, Jr., Rochelle Heights; E. Lunger, Bronx; R. G. Mead, New York city.

TRENTON, N. J.—The Hicks Motor and Manufacturing Company, of Garwood, has been incorporated to manufacture dynamos, motors, etc., for the generation or use of electricity or other energy. The capital is $25,000. Incorporators: A. B. Craft, Cranford; H. E. Hicks, Plainfield; W. B. Elliott, Westfield.

ELECTRICAL SECURITIES.

All during the week stocks were buoyant on reports of bettering conditions in all phases of industry and prospects of large crop returns. Leading securities made advances ranging from a fraction to four and five points over last week. The rumors of advances in freight rates caused a little apprehension, and if these are persistent a reaction in prices of securities is not to be unexpected. Dividends have been declared upon the following electrical securities: American District Telegraph; regular quarterly dividend of 1 per cent, payable July 22; books close July 14 and open July 22. Michigan State Telephone Company; regular quarterly dividend of 1½ per cent on the preferred stock, payable November 2, 1908; books close October 20 and reopen November 4; also regular quarterly dividend of 1 per cent on the common stock, payable September 1; books close August 20 and reopen September 2. The New Bedford Gas and Electric Light Company; regular dividend of 2½ per cent, and an extra dividend of 20 per cent. Amalgamated Copper Company; regular quarterly dividend of 50 cents per share, payable August 31 to stock of record July 23. Railway and Light Securities Company; regular semiannual dividend of $3 per share on the preferred stock, payable August 1 to stock of record of July 20. New York & Queens Electric Light and Power Company; a regular semiannual dividend of 2½ per cent on the preferred stock, payable August 10 to stock of record July 31.

ELECTRICAL SECURITIES FOR THE WEEK ENDED JULY 18.

New York:	*Closing.*
Allis-Chalmers common	10⅞
Allis-Chalmers preferred	34½
Brooklyn Rapid Transit	60⅜
Consolidated Gas	126
General Electric	143¼
Interborough-Metropolitan common	11½
Interborough-Metropolitan preferred	31¾
Kings County Electric	109½
Mackay Companies (Postal Telegraph and Cables) common	65
Mackay Companies (Postal Telegraph and Cables) preferred	66¾
Manhattan Elevated	137½
Metropolitan Street Railway	23
New York & New Jersey Telephone	107½
Western Union	55¾
Westinghouse Manufacturing Company	60¼

The Allis-Chalmers Company continues to report an improvement in its business. Orders received in the month of June show an increase of twenty per cent over the preceding month. New business in the month of May showed an improvement of eighty per cent over April. A representative of the company says that collections are better than they have been at any time in several years.

Shares of the Westinghouse Electric and Manufacturing Company made substantial gains on reports that the success of the reorganization plan is now assured and that it will be ratified by the readjustment committee when it meets September 1.

Boston:	*Closing.*
American Telephone and Telegraph	117⅜
Edison Electric Illuminating	216
Massachusetts Electric	46
New England Telephone	113
Western Telephone and Telegraph preferred	63½

American Telephone and Telegraph for the past three years has found its banking and financing relations with its subsidiary telephone associates relatively more profitable than the purely investment and banking relationship. On the whole, and as compared with the showings of American industrial corporations, the telephone companies are doing a business of increasing size and profit, and with rather slight fluctuations in pace. While the three years culminating with 1907 was a period of enormous demands for capital for construction and development, the results in earnings are of approximately equal magnitude.

Directors of the Western Telephone and Telegraph Company have declared the regular semiannual dividend of two and one-half per cent on the preferred stock, payable August 1 to stock of record July 18.

Philadelphia:	*Closing.*
Electric Company of America	10⅛
Electric Storage Battery common	30
Electric Storage Battery preferred	32½
Philadelphia Electric	9½
Philadelphia Rapid Transit	13⅞
United Gas Improvement	87
Chicago:	*Closing.*
Chicago Telephone	138½
Commonwealth Edison	103
Metropolitan Elevated preferred	48
National Carbon common	69
National Carbon preferred	110

ELECTRIC LIGHTING.

CHARLOTTE, N. C.—The Southern Power Company has completed its transmission line to Shelby.

MUNNSVILLE, N. J.—Munnsville has raised $1,200 toward capitalizing an electric light proposition, selling the shares at $10 each.

SAN JOSE, CAL.—The Tuolumne Water Power Company has been granted a franchise by the board of supervisors of Santa Clara County.

SACRAMENTO, CAL.—The Snow Mountain Power Company, of Willows, Glenn County, will commence work on its plant some time in August.

SHREWSBURY, MASS.—The selectmen have voted to borrow $16,000 to establish an electric lighting plant, which the town authorized at a special meeting in May.

OXFORD, MASS.—The contract for the construction of the heat and light plant of the University of Mississippi has been awarded Barber & Company, of Birmingham, Ala.

BROWNWOOD, TEX.—The city council has closed a deal for twenty street lights to be installed in Brownwood within the next ninety days, the contract price being $6.75 per light per month.

TRAVERSE CITY, MICH.—F. E. Hatch, of Pellston, has purchased the Chandler dam at Leland and proposes to install a powerhouse to supply electricity for Leland, Provement, Sutton's Bay and Northport.

BUTLER, MO.—At the annual meeting of the stockholders of the Butler Water, Light and Power Company the following directors were elected for the ensuing year: Dr. J. M. Christy, J. P. Edwards, J. S. Francisco and J. A. Trimble.

WEST ALLIS, WIS.—Articles of incorporation of the West Allis Light and Power Company have been filed with the register of deeds of Milwaukee County by F. C. Weed, H. G. Meigs and J. B. Meigs. The new company has applied to the city council for a franchise.

ALBANY, N. Y.—The Public Service Commission for the Second District has granted the application of the Canton Electric Light and Power Company for authority to mortgage its property and franchise for $16,000 and to issue $16,000 bonds to be secured by the mortgage.

MILFORD, MASS.—At a meeting of the selectmen a contract with the Milford Light and Power Company was ratified for one year for street lighting. The contract includes fifty-eight arc lamps of 1,200 commercial candle-power at the rate of four cents an hour for each lamp.

ALBANY, N. Y.—An agreement of consolidation of the Watertown Light and Power Company and the Watertown Gas Light Company, forming the Watertown Light and Power Company, has been filed with the secretary of state. The capital of the consolidated concern is $1,500,000.

VICTOR, MONT.—An electric light company has been formed and work has begun on a plant to supply light and power to Victor and Stevensville. The plant will be located on the Bitter Root River at Victor and an excellent site has been secured. The company promises service by early fall.

ALBANY, N. Y.—The Public Service Commission of the Second District has granted the application of the Berlin Electric Light, Heat and Power Company for permission to begin construction and examine franchises in the town of Berlin, Rensselaer County, and also to issue common stock to the amount of $17,500, the necessary cost of constructing its plant.

MUSCATINE, IOWA—The city council has passed a bill authorizing the board of public improvements to let a lighting contract, the cost of which will be about $800,000 per annum, for the lighting of the public streets at the expiration of the present contract in 1910. The council also passed a bill providing a franchise for the company that bids the lowest on the contract.

SPRINGFIELD, MASS.—For the purpose of doubling its capacity, the Home Light, Heat and Power Company intends to erect another building east of its present plant in East Washington street. A permit for a $2,000 brick structure has been issued to the company. The dimensions of the building will be fifty-three by sixty-six feet, one story high. Modern machinery will be installed.

STOCKBRIDGE, MASS.—The contract between the town and the Stockbridge Lighting Company for street lights, authorized by vote of the town at the annual meeting, has been signed. It is a twenty-year agreement providing for the use of not less than eighty lamps. The town is to pay $27 per year for each light served by the underground conduit system and $15 per year for each served from overhead wires.

COLORADO SPRINGS, COL.—Pursuant to action taken at a special stockholders' meeting in this city June 22, Vice-President R. W. Chisholm and Secretary Ira A. Miller, of the Colorado Springs Electric Company, have filed a certificate of amended articles of incorporation of the company in the county clerk's office, increasing the capitalization from $1,000,000 to $1,500,000. The capitalization will consist of 10,000 shares of common and 5,000 shares of preferred stock, all of a par value of $100 each.

LEXINGTON, KY.—Agitation against the rates for electric lighting and power has resulted in the passage by general council of an ordinance for sale of a franchise for a new company. The ordinance provides that the maximum rate for lighting shall be fifteen cents per 1,000 watts; that the life of the franchise shall be twenty years; that the plant shall not be sold to a competitive company, and that the Lexington Railway Company, which now has a monopoly here, shall not be a bidder. Colonel John R. Allen stated that a company, largely of local men and ample capital, is to be formed and will bid for the franchise. It is required that work on the plant begin not later than January, 1909.

NEW INCORPORATIONS.

CLEVELAND, OHIO—Mahoning Telephone Company, Youngstown. $10,000.

DES MOINES, IOWA—Dubuque & Delaware County Telephone Company, Dyersville. $100,000.

CINCINNATI, OHIO—Belmont Telephone Company, Bridgeport. Increase of capital from $150,000 to $250,000.

NASHVILLE, TENN.—Doe River Lighting and Power Company, Carter County. Capital stock increased from $10,000 to $15,000.

PARKERSBURG, ORE.—Parkersburg Telephone Company, Parkersburg. $2,000. Incorporators: Albert Snead, Wesley J. Haga and E. M. Randleman.

CHEYENNE, WYO.—The Cheyenne Street Railway Company. $75,000. Incorporators and directors: T. A. Cosgriff, H. M. Bennett and G. E. Abbott.

ST. PAUL, MINN.—White Earth Telephone Company, Mahnomen. $10,000. Incorporators: Charles H. Sanders, Mabel M. Sanders, Kathryne Sanders and L. G. Sanders.

ST. PAUL, MINN.—Russell Farmers' Mutual Telephone Company, Russell, Lyon County. $10,000. Incorporators: A. J. Burckhardt, president; W. C. Henrich, general manager.

ST. PAUL, MINN.—Anoka County Mutual Telephone Company, of Constance. $4,500. Incorporators: William Nelson, of Constance, president; Fred Russell, of Cedar, secretary; P. J. Johnson, of Constance, treasurer; John Simonson, Charles Haglund and Gust Soderburg, directors.

ST. LOUIS, MO.—Missouri Electric Railroad Company. $1,000,000. Incorporators: Robert McCulloch, 9,900 shares; Bruce Cameron, E. P. Walsh and H. P. Taylor, ten each; James Adkins, seventy. To construct, own and operate street railroads in St. Louis, Mo., and St. Louis County and St. Charles County, Missouri.

NASHVILLE, TENN.—Gallatin Pike Railway Company, Davidson County. $25,000. Incorporators: E. B. Rucker, C. H. Gillock, M. H. Sharpe, P. A. Shelton and J. H. Zarecor. Organized for the purpose of building and operating a railroad along the line of the Gallatin Pike from the present extension of the Nashville Railway and Light Company's road to a point on said pike where it is intersected by Maplewood Lane, a distance of about two miles.

INDUSTRIAL ITEMS.

THE ROBBINS & MYERS COMPANY, Springfield, Ohio, has issued bulletin 67, a handsome piece of literature devoted to "The Standard" motors.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., in bulletin 105, describes and illustrates polyphase induction motors, constant speed, large sizes, sixty cycles, fifteen to 250 horse-power, and twenty-five cycles, fifteen to 175 horse-power.

THE AJAX LINE MATERIAL COMPANY, Chicago, Ill., has issued bulletin 5, devoted to Ajax outdoor lighting specialties, listing and illustrating a great variety of devices of this character. Copies of this bulletin will be furnished to those interested upon request.

H. G. OSBORNE, 74 Cortlandt street, New York city, is publishing a very interesting booklet describing the Osborne extension brick drill. This drill consists of two parts: a hardened steel "drill head" and a piece of gas-pipe threaded on one end to screw into the drill head for a handle. Some surprising results are claimed for this device.

THE BRISTOL COMPANY, Waterbury, Ct., has published a new catalogue describing its staggered point steel belt lacing. The illustrations show the belt lacing in full size and the pictures are indeed convincing of the utility of this device. This line of staggered point steel belt lacing has been developed to meet the practical requirements of all kinds and widths of belting. They are made in ten different sizes and of different lengths, suitable for every thickness and width from the lightest to the heaviest conveyer belts. For the benefit of any one interested, who is not familiar with the merits of these fasteners, free samples will be sent on application.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has ready for distribution a series of bulletins devoted to several of its specialties, as follows: No. 3128, single-phase induction motors, frame 24 FA, one to twenty horse-power, full load, automatic start: No. 3129, single-phase induction motors, frame 28 EA, one to six horse-power, full load, automatic start; No. 3130, single-phase induction motors, frame 32 FA, one to eight and one to six horse-power, condensed type, full load, automatic start; No. 3131, single-phase induction motors, frame 28 JA, one-fifteenth horse-power, light-load start type for intermittent service; No. 3132, single-phase induction motors, frame 28 JB, one-fifteenth horse-power, full-load start type for intermittent service; No. 3906, family sewing-machine motors, for Singer No. 66 drophead machines, for alternating and direct current.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing a booklet entitled "A Few Suggestions on Methods of Constructing Telephone Drop Circuits," and also calling special attention to the company's "Universal" porcelain insulators for this purpose. A considerable number of illustrations are employed, showing the various methods of attaching the insulators to crossarms, poles and walls. Another folder the company is distributing is entitled "Daylight at Night," describing the Columbia tungsten lamps, for which the company is the general western sales agent. This folder gives considerable prominence to the fact that immediate deliveries of these lamps can be made from the Chicago warehouse. Data are given as to the watt consumption compared with carbon-filament lamps, this comparison being worked out on the basis of both five cents and ten cents per kilowatt-hour. An attractive thirty-two-page bulletin devoted to lighting fixtures shows a complete line for varied classes of illumination, one section being devoted to tungsten-lamp fixtures. Special attention is called to the fact that the fixtures are produced by the company's new factory organization, this insuring uniform product and prompt shipment. An important feature for those having rush orders is the "boxed" fixtures, comprising certain standard lines, carried in stock for twenty-four hours' shipment. These bulletins and catalogues will be sent to those interested upon request.

DATES AHEAD.

Michigan Electric Association. Annual meeting, Grand Rapids, Mich., August 18-21.

International Association of Municipal Electricians. Annual convention. Detroit, Mich., August 19-21.

Ohio Electric Light Association. Annual convention, Put-in-Bay, Ohio, August 25-27.

Colorado Electric Light, Power and Railway Association, Glenwood Springs, Col., September 16-18.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 6-7.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

Record of Electrical Patents.

Week of July 14.

892,983. MANUFACTURE OF HYPOCHLORITE SOLUTIONS BY ELECTROLYTIC METHODS. William P. Digby, London, England. The decomposition product liberated at the anode and cathode are shielded from the main body of the electrolyte by porous partitions.

893,015. ELECTRIC HEATING APPARATUS. William H. Ripley, Bloomfield, N. J., assignor to the Prometheus Electric Company. A housing for an electric heater.

893,067. TROLLEY-POLE ATTACHMENT. Karl O. Garner, West Alexandria, Ohio. The pole socket is slotted to receive locking projections upon the pole.

893,082. ILLUMINATED DOOR KNOB. John W. Lind, Boston, Mass., assignor to H. G. Williams and J. A. Spiker, Salt Lake City, Utah. A hollow knob with transparent face containing an incandescent lamp.

893,125. SELECTIVE SIGNALING SYSTEM. Garrison Babcock, Chicago, Ill., assignor to Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. A system employing selective devices at substations controlled from the central office.

893,147. APPARATUS FOR SIGNALING AND COMMUNICATION TO MOVING TRAINS. Henry B. De Groot and William A. Kendrick, Washington, D. C., assignors of one-fourth to Henry Copperthite and three-sixteenths to Charles E. Kendrick, Washington, D. C. A system utilizing a signaling circuit and a telephone.

893,151. DEVICE FOR TRANSMISSION TO A DISTANCE OF SOUNDS PRODUCED BY TALKING MACHINES. Eugene Ducretet, Paris, France. A microphone is attached to the horn at the talking instrument.

893,160. ELECTRIC SWITCH. David E. Gray, New York, N. Y. A battery changing switch for effecting series or multiple grouping.

893,163. COUPLING FOR ELECTRICAL CONDUCTORS. William C. Hafemeister, Cleveland, Ohio, assignor, by mesne assignments, to the Van Dorn Electric and Manufacturing Company. A coupling consisting of two similar members with plane faces and interlocking tongues.

893,214. ELECTRICALLY ILLUMINATED DOOR-KNOB MECHANISM. Henry G. Williams and John A. Spiker, Salt Lake City, Utah. A transparent knob enclosing an incandescent lamp.

893,228. DYNAMO-ELECTRIC MACHINE. Gano S. Dunn, East Orange, N. J., assignor to Crocker-Wheeler Company, Ampere, N. J. The reciprocal of the square of the air-gap length bears a constant ratio to the distance along the armature periphery from a fixed point.

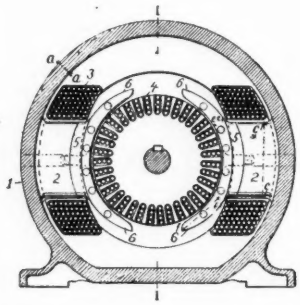
893,244. X-RAY METER. George C. Johnston, Pittsburg, Pa. A fluorescent material casts its light upon a selenium cell in a meter circuit.

893,249. TELEPHONY. Isidor Kitsee, Philadelphia, Pa. A local circuit including an enunciating device indicates the status of the trunk line.

893,250. TELEPHONY. Isidor Kitsee, Philadelphia, Pa. A trunk line closed at both terminals through sources of current in opposition.

893,265. INSULATOR. Augusto Richard, Milan, Italy. An insulator composed of two readily separable parts.

893,278. TELEGRAPHONE. Harve R. Stuart, Wheeling, W. Va. A condenser and battery attached across the recording magnet.



893,228.—DYNAMO-ELECTRIC MACHINE.

893,285. ELECTRIC CABLE INSULATOR. Edward M. Tompkins, Chicago, Ill. A petticoat insulator having an axial cavity to receive and hold the cable.

893,286. MULTIPHONE. Kelley M. Turner, New York, N. Y., assignor to General Acoustic Company. A pair of transmitters connected in multiple and attached to a horn having a plurality of receivers.

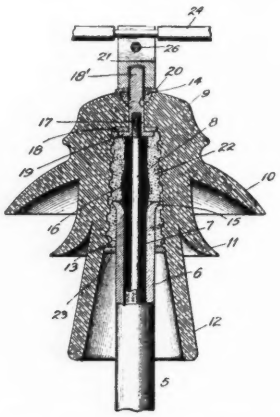
893,305. ELECTROMAGNET. Herbert W. Cheney, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. An iron-clad magnet, each of the parts having inserted a plug of higher magnetic retentivity.

893,314. MAGNET-ACTUATED SIGNAL BELL. Harold W. Eden, Detroit, Mich., assignor to P. R. Manufacturing Company, Detroit, Mich. A vibrating call bell.

893,330. SECONDARY BATTERY. John Knobloch, New York, N. Y., assignor, by mesne assignments, to Franz Sigel, New York, N. Y. The elements are built up of a series of perforated tubes enclosing the active material.

893,351. CURRENT DIRECTOR. James F. McElroy, Albany, N. Y., assignor to Consolidated Car-Heating Company, Albany, N. Y. A group of four variable carbon resistances controlling the current through the motor.

893,370. DYNAMO-ELECTRIC MACHINE. Howard H. Ralston, Norwood, Ohio, assignor to the Bullock Electric Manufacturing Company. An adjustable brush gear.



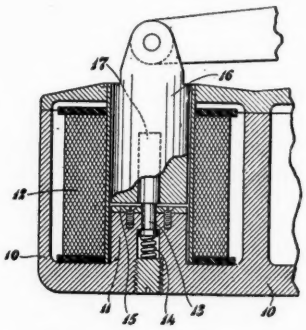
893,285.—ELECTRIC CABLE INSULATOR.

893,382. ELECTRIC CIRCUIT CONTROLLER. Dane B. Sawyer, Paterson, N. J. A motor controller having a vertical moving contact bar.

893,402. AUTOMATIC ELECTRIC SIGNAL SYSTEM. Earle Van Briggle, Kokomo, Ind., assignor of one-half to Charles M. Brooker, Kokomo, Ind. A signal controlled by a pair of differentially operating solenoids.

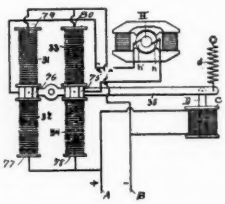
893,414. TELEPHONE SWITCHING AND SIGNALING APPARATUS. James G. Wray, Chicago; Herbert T. Gardner, Maywood, and William G. Kinton, Chicago, Ill., assignors to American Telephone and Telegraph Company. A signaling system for trunk lines.

893,533. ELECTRIC-LIGHTING SYSTEM. James F. McElroy, Albany, N. Y., assignor to Consolidated Car Heating Company. A train lighting system employing a variable-speed magnetically regulated dynamo.



893,305.—ELECTROMAGNET.

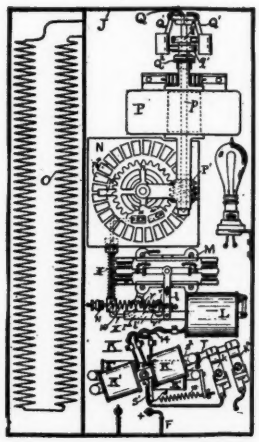
893,534. ELECTRIC-LIGHTING SYSTEM. James F. McElroy, Albany, N. Y., assignor to Consolidated Car Heating Company. A train-lighting system depending for its control on the condition of the battery.



893,351.—CURRENT DIRECTOR.

893,536. ELECTRODYNAMIC BRAKE. Frederick W. Newell, Hastings-upon-Hudson, N. Y., assignor to Otis Elevator Company, Jersey City, N. J. A brake controlled by a differential relay to prevent generator action of a motor.

893,555. WIRE FASTENER. Cornelius F. Sullivan, Boston, Mass., assignor to Frank W. Lowe, Boston, Mass. A coupling sleeve formed of a spirally wound wire.



893,533.—ELECTRIC-LIGHTING SYSTEM.

893,565. ELECTRODE. Henry S. Blackmore, Mount Vernon, N. Y. An electrode composed of a metal-carbon-containing compound and a binder.

893,586. THERMAL CUTOUT. Bryson D. Horton, Detroit, Mich. A fuse composed of a group of wires, none of which alone would carry the normal current.